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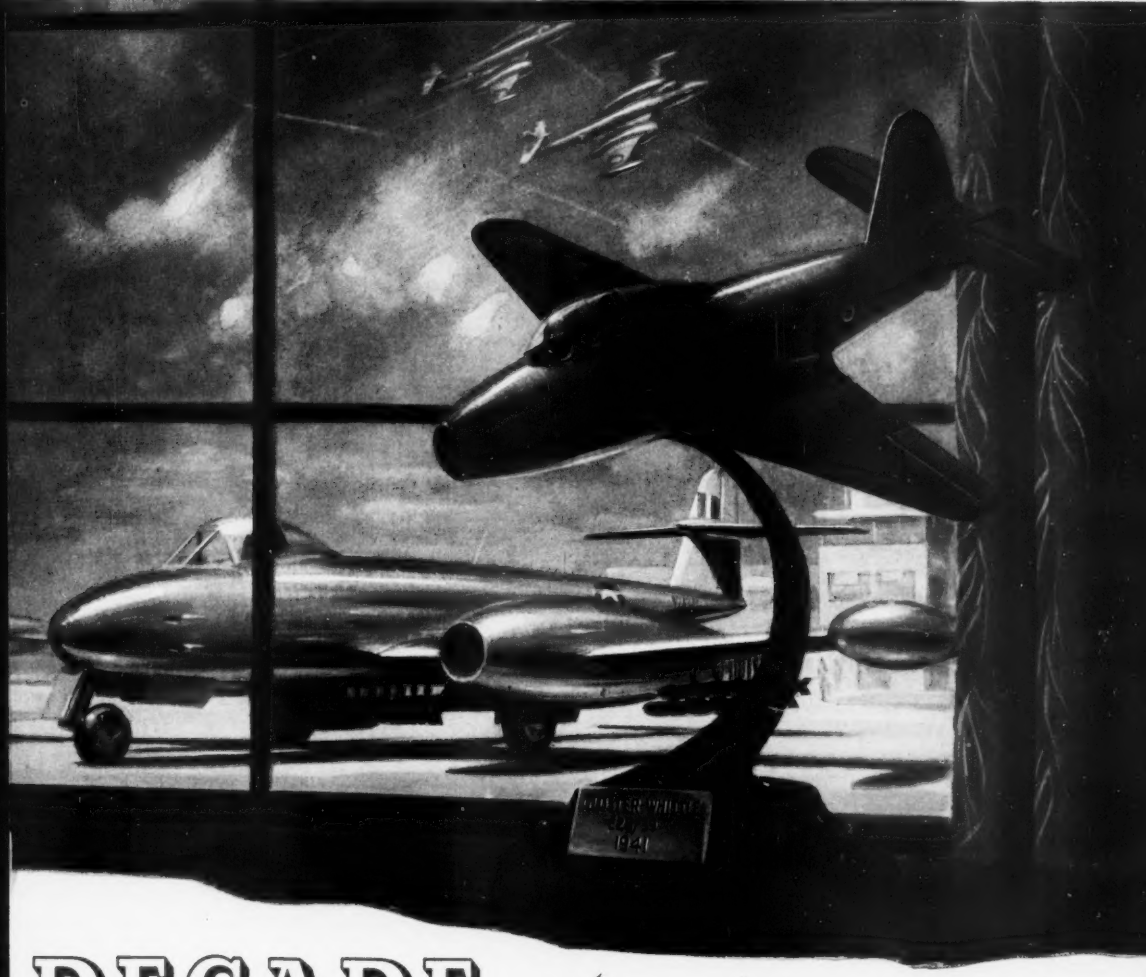

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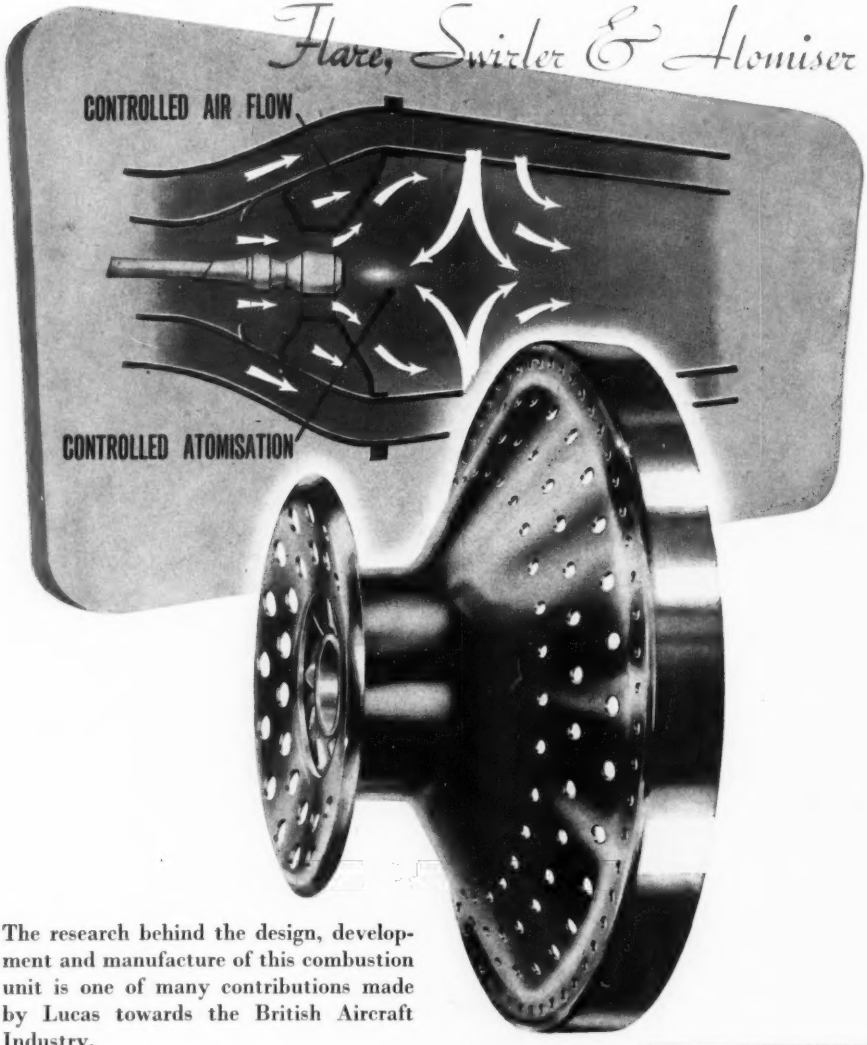

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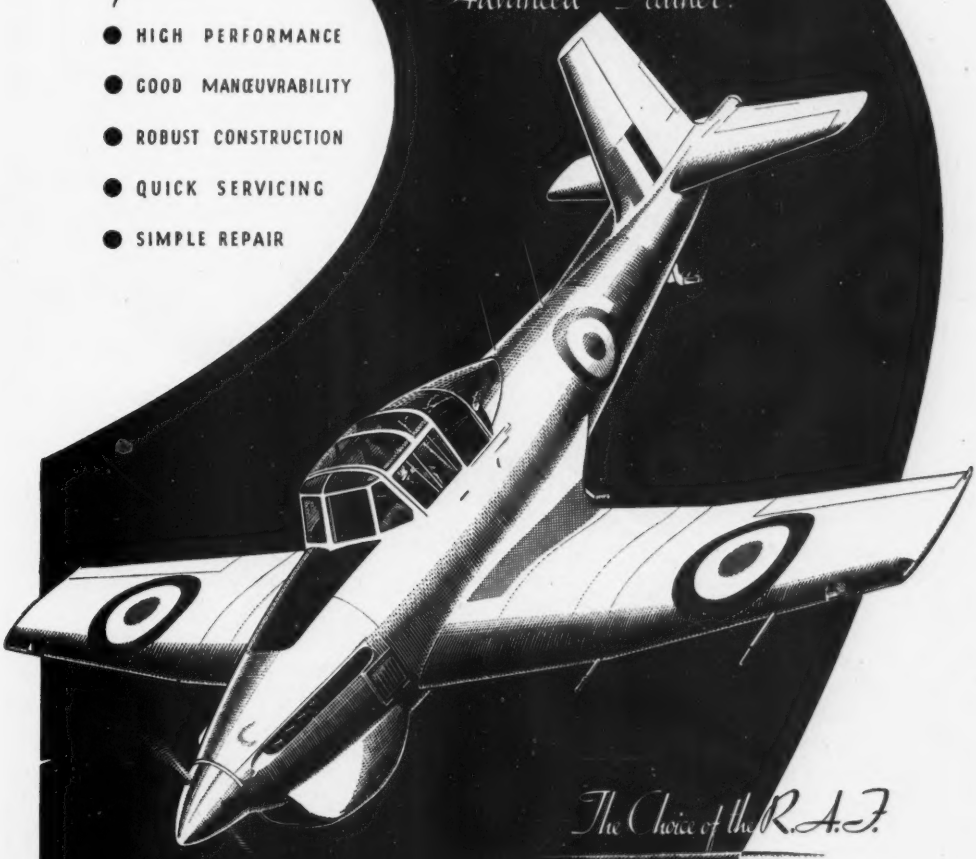

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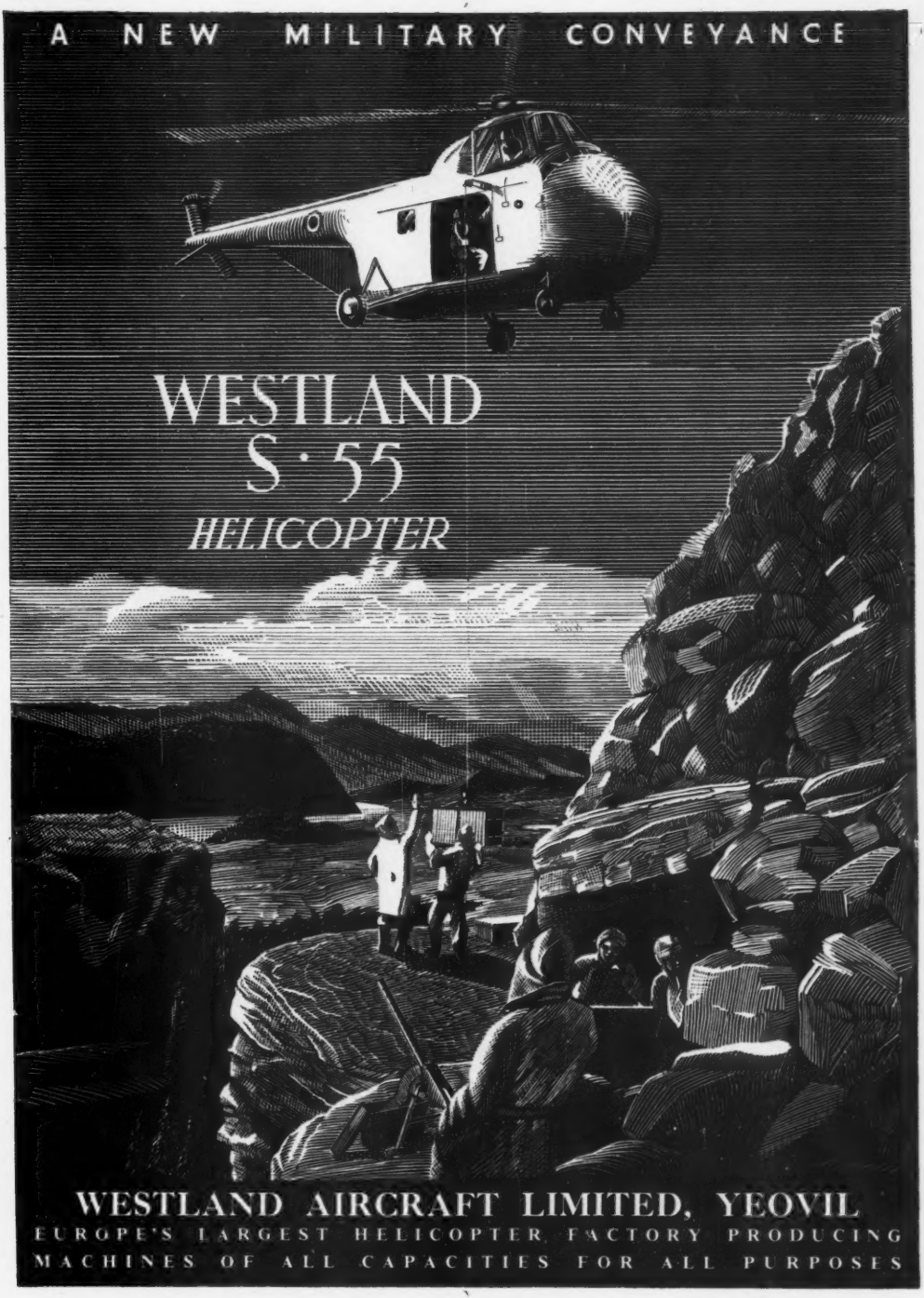
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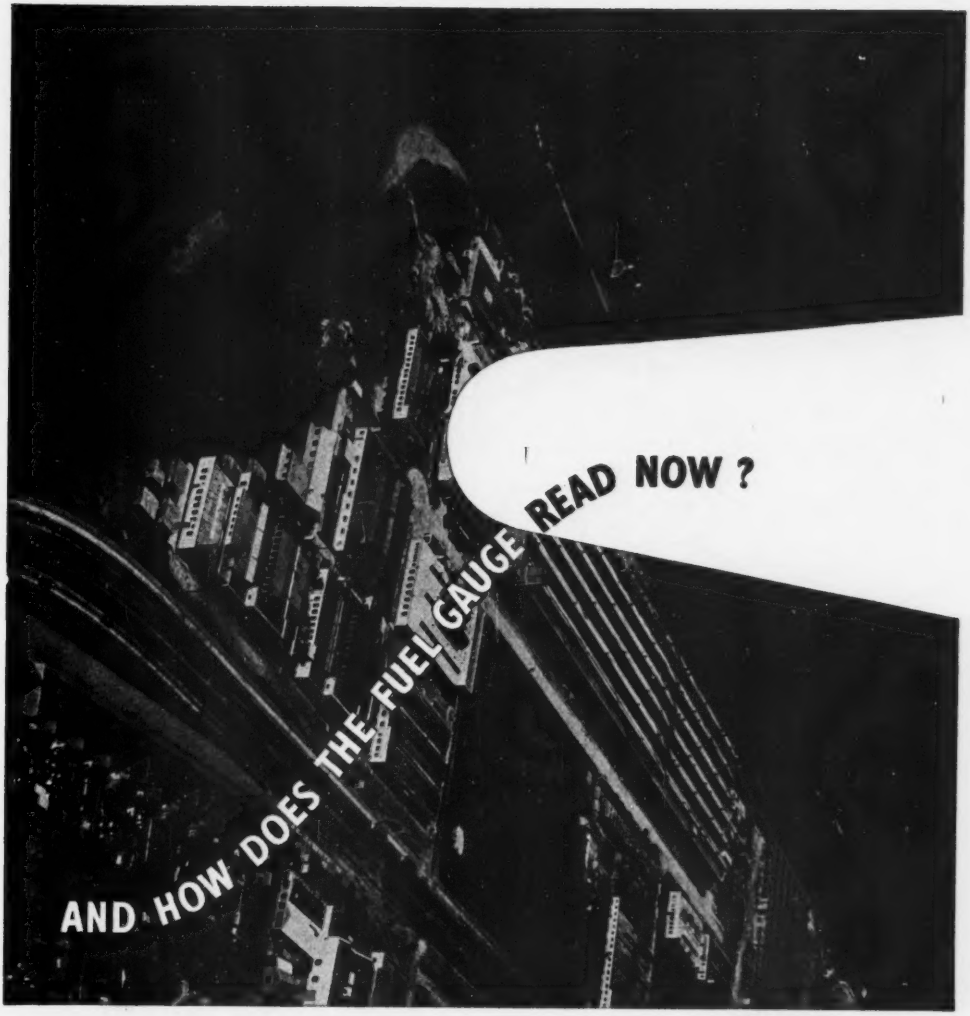

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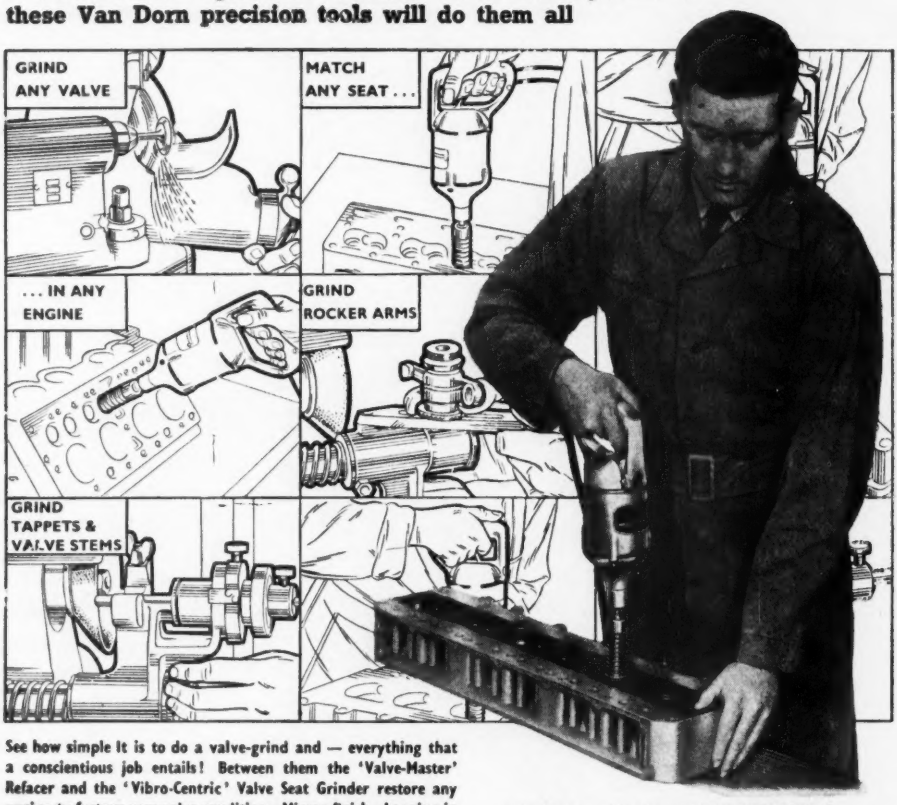

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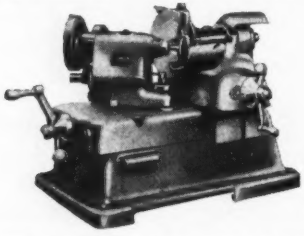

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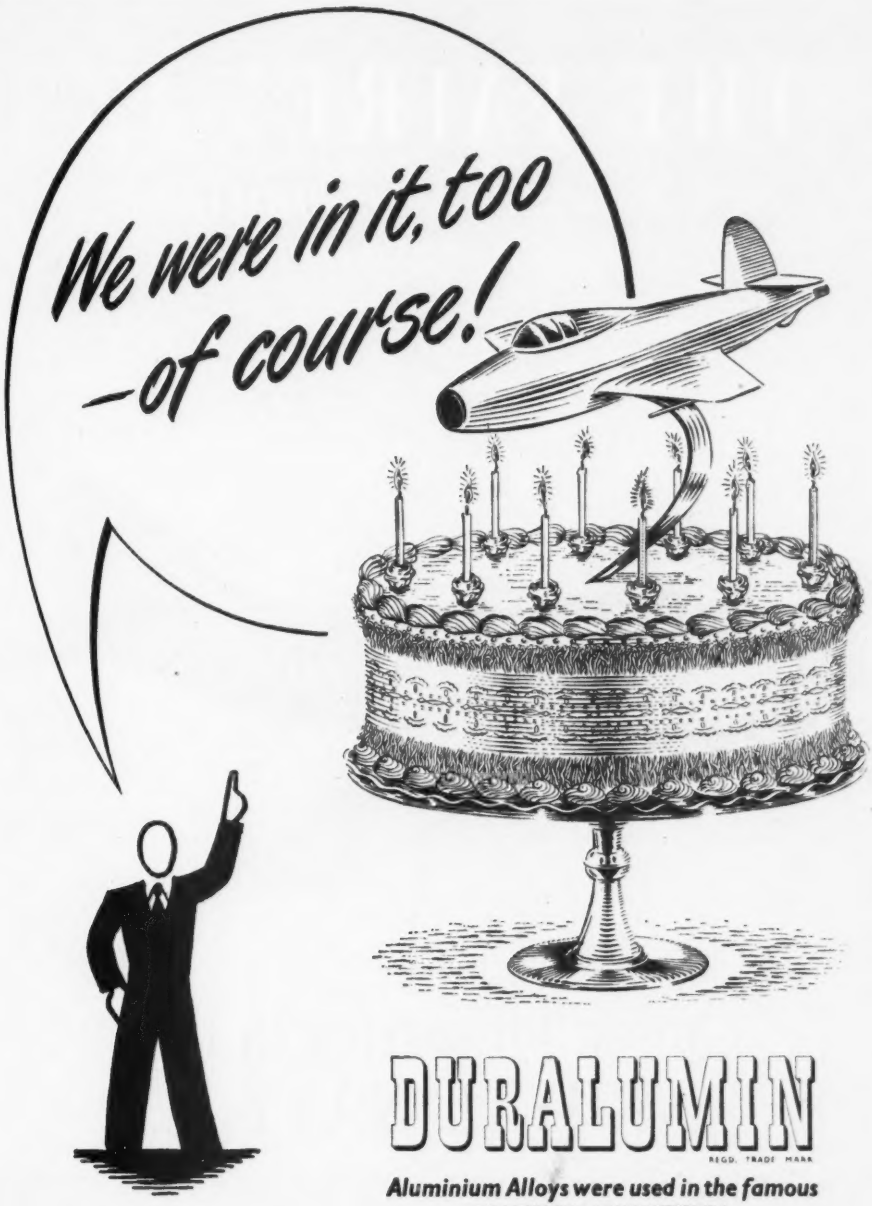

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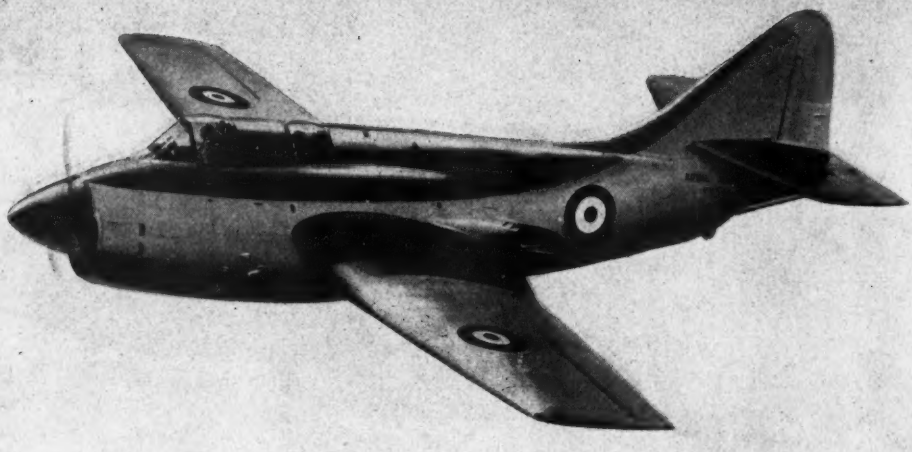

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Founded 1909

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Turbine Decade

AT 7.40 p.m. next Tuesday, May 15th, exactly ten years will have passed since that prince of good fellows, the late P. E. G. Sayer, lifted the Gloster E.28/39 monoplane from the runway at Cranwell on its maiden flight—the first by a British jet aircraft. To Jerry Sayer, therefore, the honour for making flying history and to W. G. Carter, who watched anxiously on that evening, the credit for designing the historic little machine. But, above all, tribute to Sir Frank Whittle, who also watched, and saw the first fruit of his early struggles—a practical turbojet—thrust the E.28 into the air after a run of 500-600 yards.

John Grierson, chronicler of and participant in the pioneer experiments of those days, has related that it was too late in the evening to make any special arrangements for celebrating, so all hands repaired to the sergeants' mess for an impromptu party. But when, in London on May 31st next, at a banquet of worthy proportions, the famous and privileged assemble in honour of the E.28's achievement, there will be no greater rejoicing than on that summer evening a decade ago. Certain it is that there will be abundant satisfaction at Britain's accomplishments in the years between.

Many of the guests will remember that the first twin-jet Gloster Meteors played their part in countering the scourge of the flying bombs, and in this regard someone may hark back to a jet "first" which is seldom given recognition—that is, the first victory of a jet fighter over an enemy aircraft (for the flying bomb was truly a pilotless aircraft). The date was August 4th, 1944, when a certain F/O. Dean, with his guns jammed solid, nudged a V.1 with the wing of his Welland-powered Meteor south of Tonbridge and sent it down.

Other "firsts" crowd to the mind. The Trent-Meteor—the first aircraft to fly with airscrew-driving gas turbines; the Vickers-Armstrongs Viscount, first civil transport with turboprop power; the de Havilland Comet, first pure-jet transport; the Boulton Paul Balliol, first turboprop trainer; the de Havilland Sea Vampire and Fairey G.R.17, respectively the first turbojet and turboprop machines to operate from the deck of an aircraft carrier; the special Ghost-Vampire, first aircraft to break the world's altitude record using gas turbine power; the English Electric Canberra, first—and still the only—jet aircraft to fly the Atlantic non-stop; the Saunders-Roe S.R./A1, first jet flying boat; and so on to a very impressive total.

Aid for America

Deep satisfaction is felt that the achievements of British gas-turbine engineers should have profited not only ourselves but our good friends the Americans. Since the days when General "Hap" Arnold ordered a Liberator to Britain to ferry the W1X unit back to the U.S.A. there has been valuable collaboration and ever-sharpening competition. In recording that Pratt and Whitney are turning out Rolls-Royce Nenes and Tays by the hundred, and that Curtiss have been authorized to build Armstrong Siddeley and Bristol units of very advanced design, we are conscious that powerful and promising turbojets and turboprops of domestic design are already on the test-beds in America. We relish the competition confronting us, not only from America but from countries of the Old World—France and Sweden in particular. Only last week it became known that a new Swedish turbojet is being installed in a Lancaster for development flying.

That so much of the effort exerted in the early years of turbine power for aircraft should have been directed to military ends is deplorable; but the pleasing fact remains (and here we would applaud the prescience of the Brabazon Committee and the Ministry of Supply) that the Comet, Viscount, Apollo and Hermes V have set a new pace for the airlines of the world.

That a British jet aircraft was the first to fly we have never asserted; but we do pride ourselves that, in the development of practical gas turbine power plants and in their application to many classes of aircraft, we took the lead early and we give notice that we propose to retain it.

THE GARDEN PARTY

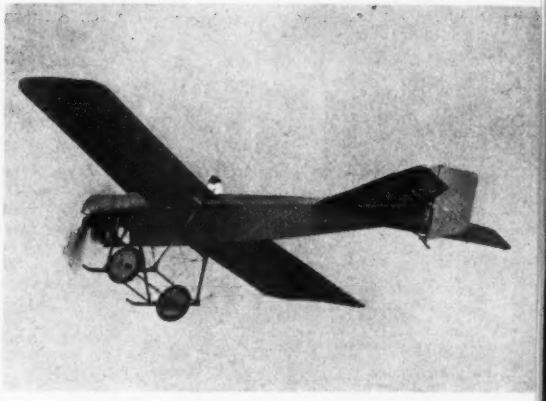
Guests of the R.Ae.S. Again Beguiled by Aerostats and Aerodynes of Yesteryear

Illustrated by "Flight" photographs

THE Royal Aeronautical Society having gone into business for themselves as aeronautical publishers (see programme of last Sunday's Garden Party), we essay our account of that event with some diffidence. But observing that in format and typography their chronicle is hardly calculated to put a journal—admittedly only of 41 years' standing—out of the running, we are emboldened to proceed.

A chilling wind nagged throughout the afternoon, and White Waltham (loaned as usual by Sir Richard Fairey and the Ministry of Supply) was of far less summery aspect than could have been wished. But the wind which would prevent the "Aeronauticals" from enjoying their Garden Party has yet to blow, though the opinion was voiced more than once that this particular occasion was less refreshing in its interest than former gatherings.

Pending the onset of aviation, many visitors sought refuge from the weather in "The Static." We may therefore record the exhibits in that section before describing the display.



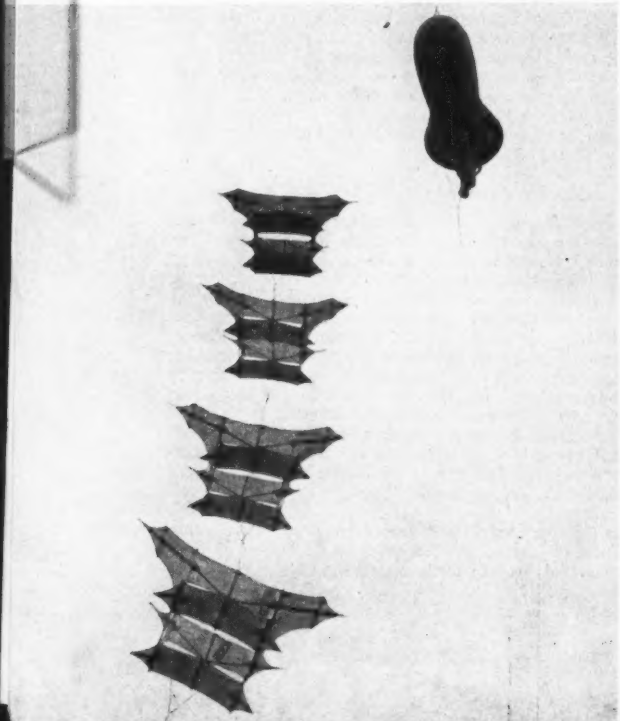
Breasting the wind is the Blackburn monoplane of 1912 (from the Shuttleworth Collection). Engine, 50 h.p. Gnome; pilot, Gordon Banner.

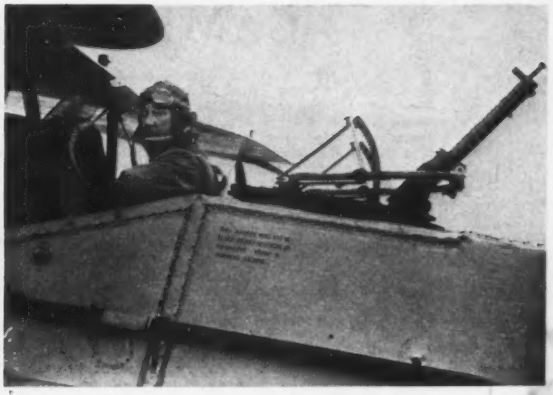
Rubbing wing-tips with a spruce-looking Swordfish was a work-worn Handley Page Gugnunc of 1928 (speed range, 33-112 m.p.h.), a Sopwith Triplane and—technically the most interesting of all—a Westland-Hill Pterodactyl Mk I, designed by Capt. G. T. R. Hill and built in 1926. Rigged for demonstration with compressed air was the recently discovered Frost ornithopter steam engine—1877 brain-child of one E. P. Frost, sometime president of the Aeronautical Society.

One left this engaging little power plant to see the President of the Society, Major G. P. Bulman, and Mrs. Bulman set down in the Westland-Sikorsky S-51, with Mr. D. Colvin in control. G/C. Gordon Slade, O.C. Flying for the day, and lately responsible for the first flight of the projectile-like Fairey Delta, proved his adaptability by smartly positioning the step-ladder for the Presidential descent.

(Above) The President of the Royal Aeronautical Society, Major G. P. Bulman, on arrival with Mrs. Bulman in the Westland-Sikorsky S-51.

Riding the gusts on the left are the Cody-type man-lifting kites and R-type observation baloon, two attractions provided by Cardington.





The Bristol Sycamore is seen on a fast run. A helicopter of this type is to be delivered to the R.A.A.F. by Bristol Freighter. Mr. "Bill" Pegg (right), who delighted everyone with his performance on the Bristol Fighter, showed that Brabazon-piloting has not left him ham-fisted.

The first aerial performance was that of Ian Forbes in the amazingly spritely Lycoming-powered Miles Aerovan Mk 6. This, of course, is by no means a "has-been" (it was built in 1947), and it offers a challenge which no other machine of its class is yet able to take up with impunity. A.V-M. Don Bennett took time off from his airliners to demonstrate the Youngman-Baynes monoplane, built in 1947 for high-lift research and now operated by Fairflight, Ltd. It has full-span, retractable aerofoil flaps and inset ailerons. Even higher lift was displayed by the "R" type observation balloon of the Balloon Unit, R.A.F. Cardington, which rode the gusts somewhat sickeningly on 700ft of cable. Then a string of four Cody-type man-lifting kites tugged skywards, with a near-relation of Major Sandbags dangling nonchalantly, his moustache "soft-lifted by the winnowing wind." The first British free balloon built since 1933 (a spherical type of 28,000 cubic feet capacity and

The appealing little M.B.308, with 85 h.p. Continental C-85 engine, was flown—as proclaimed by its registration—from Italy, by Signorina Cassini.

with a four-passenger basket) remained deflated. Another non-participant was the airship *Bournemouth*, which is not yet ready to sally forth from Cardington to crusade in the lighter-than-air cause.

Mr. F. G. Irving showed off the lines and capabilities of an Olympia Mk 2 glider in impeccable style, and Mr. C. G. Alington exhibited the dainty form and lively performance of the Tipsy B. This Fairey presentation was succeeded by a second, involving Mr. Peter Twiss in a Swordfish. Blazoned on the fin was the badge of the Aircraft Torpedo Development Unit and in the bath-like rear cockpit romped a trio of high-spirited passengers. As Twiss threw the silver "Stringbag" around with nautical verve, these worthies improved the shining hour by standing on their heads, attempting to embrace the pilot and generally comporting themselves in a diverting manner. Entering into the spirit of the proceedings, Twiss gave himself a batsman's wave-off on one very low run and duly went round again.

To many eyes the most beautiful machine present was the Bristol Fighter. In this endearing old war-horse Bill Pegg gave a reminder that he is no mere "Brabazon-basher," but that in his time he has been a fighter pilot and instructor of no mean ability.

Signorina Nina Cassini made Italy's charming contribution in the fixed-tricycle Macchi-Bazzocchi MB.308. Name, pilot and aircraft are equally attractive. Hawker's Frank Murphy gave the best performance yet in the 1924 Cherub-engined Hawker Cygnet.

Mr. John Fricker took full advantage of the stiff wind and of his 32 h.p. Carden-Ford engine to delight the assembly with his 1936 B.A.C. Drone. Somebody made him a tempting offer for it on the spot. No doubt, also, there were others present who would have been glad to make a fat cheque for the Sopwith Pup, handled in the [illegible] spirit by R. F. Martin. Another first-rate show [illegible] on the side-by-side Blackburn B.2 [illegible] followed by the nimble, paras[illegible] of 1938, with D. D. Budworth up.

A de Havilland Dragon, its cabin populated by trippers, and with T. E. Scott-Chard in the driver's seat, exhibited none of the reluctance of its film-famous kinsman, and Neville Duke, in Hawker's trim blue-and-gold Tom Tit, put on the prettiest aerobatic display of the day. His falling leaf captivated everyone—especially those (and there were many) who had never before witnessed this manœuvre.

Mr. F. Bullen, whose renditions, like those of his Hawker chief, Neville Duke, are much appreciated by the connoisseurs, put the 14,000th Hurricane *Last of the Many* through an uncompromising sequence of aerobatics with wheels down. His undercarriage light was literally "on the blink," and he was unaware of the source of the extra drag until he had completed his roll. Bristol's C. T. D. H. Hosegood went astern in the Sycamore (171 Mk 3) helicopter, and then proceeded full ahead at a spanking rate. The Sycamore is an unusually fast, tractable, and good-looking specimen of its kind.

In our own view the honours of the day went to Gordon Banner in the Blackburn 1912 monoplane. This oldest inhabitant whirred its way off into the gusting wind, turned cautiously but with determination on to the down-wind leg, and battled its way back into wind for landing. It received the same sort of spontaneous ovation as grandmother is accorded when she concludes her Christmas polka.

To close the proceedings Pat Fillingham went through his Chipmunk routine; so the thousands who know it will judge that the afternoon ended on a high note.

CAMBRIDGE "AT HOME"

LAST Saturday, May 5th, Marshall's airfield at Cambridge (No. 5 Reserve Centre, R.A.F.) was the scene of one of several meetings which take place during the year in which members of the R.A.F.V.R. compete against each other in a programme of flying events. In this case the competition formed part of a varied and absorbing programme of individual aerobatic displays, formation drill and gliding and parachute demonstrations which, despite the ominous appearance of the sky and a succession of wintry showers during the afternoon, was well attended and ran from start to finish without a hitch.

At 1500 hours nine Seafires of No. 1832 R.N.V.R. Squadron (based at Culham) set a high standard of precision flying with some well-executed air drill. There followed the first performance in the formation contest, the Chipmunk team of the Cambridge University Air Squadron. A faultless display of aerobatics in a Vampire of No. 72 Squadron was then given by S/L. D. E. Kingaby, D.S.O., D.F.M., who, incidentally, was a former pupil at "22."

The formation team of No. 22 R.F.S. then took to the air and during the next ten minutes showed that the Chipmunks were in well-practised hands, the neatness and versatility of their performance giving them the extra points needed to bring home the Challenge Bowl, awarded to the team gaining the highest aggregate in all contests. (Points gained in a navigation contest held during the morning also counted towards the total.)

F/O. Hubbard, a war-time instructor and now C.F.I. of the R.F.S., answered requests for individual aerobatics in pleasing fashion; on landing his place was taken in the air by the third team (the Varsity Flight) to take part in the Formation Contest. A parachute descent by P/O. Johnny Ralling, with his customary gasp-raising delayed drop and amusing 'chute-borne acrobatics, took place at 4 o'clock, just a few minutes before a rain shower which, being of short duration, fortunately did not hamper the next event. This was a fine display of air drill by the combined forces of C.U.A.S. and 22 R.F.S. Eight Chipmunks carried out a series of tight "arrowhead", "open-box" and echelon formations, finishing up with an impressive peel-off from echelon and a stream-landing.

The mighty buzzing of hard-worked Gipsy Majors was replaced by the fascinating "swish" which characterizes the flight of a sailplane, low-down and at high speed: after being towed off by a Tiger Moth, an Olympia flown by Mr. J. Grantham of the Cambridge University Gliding Club delighted the crowd with some tight and graceful aerobatics. In true exhibition-style the sailplane landed off a stall turn just a few yards in front of the spectators.

The last half-hour of the programme was devoted to a spot-landing contest in which several pilots revealed a singular determination to hit the spot, even if not to float gracefully down on to it. At the end of the afternoon a presentation of prizes was made by G/C. R. J. Gosnell, D.S.O., D.F.C., of 61 Group, Home Command, who complimented all pilots of the Reserve Centre on their high standard of flying. He mentioned, during a short speech, that there were still a number of vacancies for pilots in the R.A.F.V.R. at Cambridge, and expressed the hope that more existing members would volunteer for the three-months refresher course in which, he said, it was intended that pilots should at least work up to getting airborne in Vampires. The prizes were awarded as follows: Challenge Trophy Bowl (for highest aggregate of points in all competitions), No. 22 R.F.S. Formation Competition, No. 22 R.F.S. Spot-Landing Competition, (1) F/O. Scott (22 R.F.S.), (2) P/O. Roberts (Varsity Flight), (3) Sgt. Wolf (22 R.F.S.). Treasure Hunt, (1) F/O. Back (22 R.F.S.), (2) F/O. Taylor (22 R.F.S.), (3) F/S. Alderton (22 R.F.S.).

FROM ALL QUARTERS

French Airline Orders Comets

THE de Havilland Aircraft Company states that it is authorized to announce that the Chargeurs Réunis S.A. of Paris have placed an initial order for two Series I Comets, fitted with Ghost turbojets.

The aircraft will be operated by a subsidiary company, the Union Aéromaritime de Transport, which operates scheduled services connecting Paris with Dakar, Abidjan and Brazzaville, in Africa, with Saigon, in French Indo-China.

The two Comets are expected to be delivered in the autumn of 1952.

Blackburn Changes

IT is announced by Blackburn and General Aircraft, Ltd., that Mr. E. Turner, A.C.A., has been appointed acting managing director in the place of Maj. F. A. Bumpus, F.R.Ae.S. Major Bumpus (who remains on the board) also relinquishes the post of managing director of the subsidiary company, Blackburn (Dumbarton), Ltd., but remains as chairman. Mr. W. A. Hargreaves, M.B.E., A.M.I.C.E., F.R.Ae.S., has been appointed to the parent company's board as works director and also becomes managing director of the subsidiary.

Mr. Turner, who is a chartered accountant, joined the company at the end of the war and was appointed secretary in 1948. During the war he rose from the ranks to lieutenant colonel, and in the latter part of his service was in command of a rear airfield maintenance organisation in Burma which was responsible for the supply by air of men and material for the 12th and 14th Armies. His experience of that first large-scale airlift is a coincidence in view of the fact that Blackburns are proceeding with flight trials of the big Universal Freighter.

Mr. Hargreaves, who has been with the company for over 25 years, went to Dumbarton as works manager in 1942. He was made an M.B.E. in the 1946 New Year's Honours List for his outstanding work in connection with Blackburn's war production of Sunderlands, which eventually rose to one flying-boat every three working days. He was in charge of the switch-over to aluminium houses in 1945, building up output of them to over 200 per week.

Maj. Bumpus, who recently had the bad luck to break a leg whilst ski-ing in Switzerland, has been acting managing director since July of last year. He has been associated with Blackburns since the First World War, and on demobilization early in 1919 was appointed chief designer and became a director shortly afterwards.

Mr. R. H. Stone, A.C.A., who was originally with the General Aircraft Company, has been appointed secretary of Blackburn and General Aircraft in the place of Mr. Turner.

Mr. E. Turner.

Mr. W. A. Hargreaves.

Festival Race Entries

IN the Festival of Britain National Air Races, entries for which were announced by the Royal Aero Club last week-end, H.R.H. Princess Margaret has entered aircraft in four classes. In each case her pilot will be G/C. Peter Townsend, Deputy Master of the King's Household. He is to fly the famous old Hawker Hart "MR" in the King's Cup and (concurrently) Kemsley Trophy Races, while in the R.Ae.C. Jubilee Trophy event and the Air League Cup contest he will handle another veteran fighter, the Hurricane 2c.

The entry lists show that, as was expected, the classic King's Cup Race has attracted by far the biggest entry—97. The majority of the aircraft are of the private-owner type and are representative of many years of development. Almost all the primarily racing aircraft which have competed regularly in speed events during the last few years are entered, and this time a Mew Gull (H. E. Scrope) will be seen again. Among the true veterans, apart from the Royal Hart, are an Avro Avian (Capt. R. E. Gillman) and the Hawker Tom Tit (S/L. Neville Duke); there are also a number of early D.H. types, such as Leopard and Hornet Moths. *Flight's*

Gemini, G-AFLT, will be competing, with the Editor, W/C. M. A. Smith, at the controls.

Five aircraft are entered for the Grosvenor Cup, which will be awarded for the highest speed attained by any one of the five—which are within a certain weight category—during the King's Cup, while other "concurrent" classes, with the number of entries attracted, are for the Norton-Griffiths Trophy (6) and Kemsley Trophy (7).

The R.Ae.C. Jubilee Trophy has attracted five entries (the Hurricane, Sea Fury, Spitfire 22, Vampire N.F.10 and Venom 1); in the Air League Cup there are three (Hurricane, Sea Fury and Spitfire 22) and the S.B.A.C. Cup contest will be a two-man affair between John Cunningham (Vampire N.F.10) and John Derry (Venom 1).

The meeting takes place at Hatfield on June 23rd.

Inquest on S/L. T. S. Wade

AT the inquest on S/L. T. S. Wade at Lewes, Sussex, on Friday, May 4th, the cause of the accident and the pilot's death was not established. The body of the pilot, still strapped in his seat, was found 850yd from the main wreckage of the aircraft, which crashed in a field at Ringmer. The M.C.A. investigation officer, Mr. J. H. Lett, told the coroner that the ejector seat appeared to have operated normally, and there was no evidence that any other part of the aircraft had become detached in flight. An examination by the manufacturers had failed to reveal any evidence of mechanical failure or defect to which the accident could be attributed. The coroner suggested that something might have gone wrong which caused the pilot to decide to operate the seat mechanism and that that took place perfectly normally. Then something happened immediately afterwards, possibly a blow knocking him unconscious, thereby preventing him from operating his parachute. Mr. Lett said that that would be possible.

Test Pilots' Risks: Commons Questions

ON April 30th a number of questions were asked in the House regarding aircraft ejector seats. Mr. P. B. Lucas, for example, asked the Minister of Supply whether the Hawker P.1081 experimental aircraft in which S/L. Wade lost his life was equipped with a Martin-Baker ejector seat, or what make of seat was fitted; and whether the Martin-Baker ejector seat would in future become a standard fitment in all single-seat, high-speed experimental aircraft. He also asked whether the Minister would issue instructions for all such existing aircraft at present equipped with ejector seats of another make to be modified at once to take those of Martin-Baker design. Lord Malcolm Douglas-Hamilton asked what type of ejector seat was used in the Hawker P.1081; whether this type of seat was standard equipment in Service aircraft; and how many live drops had been completed.

In answer Mr. G. R. Strauss said that the experimental Hawker P.1081 aircraft was fitted with an ejector seat made by M. L. Aviation, Ltd., and preliminary indications were that the seat functioned properly. Two makes of ejector seat, this and the one by Martin-Baker, Ltd., had been approved for use in Service aircraft and it would be undesirable to have a monopoly of either of them. Live test ejections from aircraft were not called for by the M.o.S., and he was not aware of any having been made with the M.L. seat.

Mr. Lucas then asked the Minister if he was satisfied that the same measure of safety was afforded by the M.L. seat as by the Martin-Baker seat in view of the fact that no live drops had been effected by the M.L. seat, and Mr. Strauss replied that no live drop was called for before the device was accepted. He had no reason at the moment to doubt that the M.L. ejector was as good as the other one.

In answer to another question Mr. Strauss went on to say that both types of seat had been approved, and had been considered by technicians concerned to be reliable. Preliminary investigations had shown that on this occasion the seat did function properly.

A. Cdre. Harvey asked if, in view of the high fatality rate among civilian test pilots, the Minister would go into this matter in rather more detail and have proper tests carried out on both seats to establish which was the better, so as to give the test pilots the best equipment available. Mr. Strauss replied that the advice given to him was that both seats were equally good.

Attention was next turned to insurance for test pilots, and Mr. Lucas asked the Minister of Supply what arrangements were made for the insurance of the lives of his Department's test pilots; in what sums were such lives insured; and upon whom rested responsibility for the payment of premiums. Mr. Strauss said that test pilots employed by his Department were covered by the National Insurance Industrial Injuries scheme. Payments under this scheme might by supplemented by awards made by the Treasury under the Civil Service Injury Warrants, which made special provision for flying accidents.

Mr. Lucas asked whether he was satisfied that these meagre provisions were really satisfactory, in view of the hazardous nature of the flying that these test pilots daily undertook, and Mr. Strauss said that that was a difficult question to answer. A claim put forward for increased pay by these pilots was now being considered by the Treasury and his Department.

Mr. G. E. Sugden (left) has been appointed assistant general manager of Sperry's aeronautical department. Mr. T. D. M. Robertson (right), has joined Scottish Aviation, Ltd. Both appointments are referred to below.

Sperry Appointment

APPOINTED as assistant general manager of the aeronautical department of the Sperry Gyroscope Co., Ltd., is Mr. George E. Sugden, who joined the company in 1947. He was formerly technical assistant to the aeronautical manager.

During the war Mr. Sugden was engaged on radar work, first at an Air Ministry establishment and later with the R.A.F. Before joining Sperrys he was on the staff of the M.O. Valve Co.

T. D. M. Robertson Goes North

FROM Scottish Aviation, Ltd., Prestwick, comes the announcement that Mr. T. D. M. Robertson has joined the board of directors and has been appointed general manager of the aircraft manufacture and design side of the business.

Mr. Robertson was, until recently, a director and general manager of Hawker Aircraft, Ltd. He had joined the Kingston firm 17 years previously as an accountant.

Scottish Aviation, Ltd.—one of the few representatives of the aircraft industry north of the Border—are, of course, well known as the makers of the Prestwick Pioneer and, latterly, for their conversion contract on the B.E.A. Dakotas, now re-appearing as Pionairs. The firm has an extensive repair and sub-contract organization.

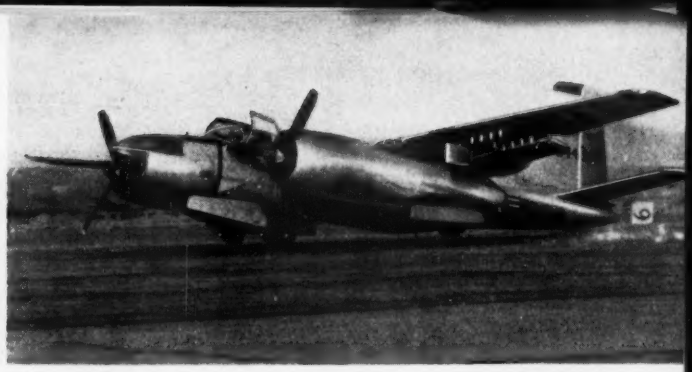
Boulton Paul Directorships

OWING to pressure of other business, Mr. R. G. Simpson has resigned from the board of directors of Boulton Paul Aircraft, Ltd., and Mr. J. D. North has been elected chairman in his stead. Mr. North will continue as managing director.

FORTHCOMING EVENTS

May	12-14.	Aero-Club de France: Champagne Rally.
May	13-14.	S.M.A.E. International Model Competitions.
May	14.	S.S.A.F.A.: Air Display, Hucknall, Notts.
May	19.	Darby Aero Club: "At Home" and Flying Display.
May	19.	Helicopter Association: Annual General Meeting.
May	20.	Kent Coast Flying Club: "At Home" (sponsored by A.B.A.C.).
May	20.	Veteran Car and Aircraft Rally, Old Warden Airfield, Biggleswade.
May	26.	Newcastle-on-Tyne Air Display.
May	26.	Wolverhampton Aero Club: "At Home" (sponsored by A.B.A.C.) and Goodyear Trophy Race.
May	31-	Iranian International Rally.
June	3.	
June	2-4.	Yorkshire Aeroplane Club: International Rally.
June	2.	Auster Flying Club: Rally, Rearsby.
June	3.	Auster-Ragosine Homing Trophy, Rearsby.
June	8-10.	Air Circuit of Sicily.
June	8-15.	Spanish International Rally.
June	9.	Rally and Race, Fairwood Common Aerodrome, Swansea.
June	9-10.	Royal Air Forces Association: Annual Conference, Torquay.
June	10.	Lancashire Aero Club: "At Home" (sponsored by A.B.A.C.).
June	15-18.	Royal Danish Aero Club: International Rally.
June	15-	Paris Aero Show.
July	1.	
June	23.	R.Ae.C.: Festival of Britain National Air Races, Hatfield.
June	24.	International Rally, Pisa, Italy.
June	24.	Northern Heights Model Flying Club: Gala Day, Hawker Airfield, Langley.
June	27-28.	Institute of the Aeronautical Sciences: Annual Summer Meeting, Los Angeles.
June	30-	Cognac International Rally, France.
July	1.	

HERE AND THERE



PANCAKE IN PERFECTION: By good luck the wheels of this Douglas Invader—its hydraulic system damaged by small-arms fire in Korea—have been extended just sufficiently to take some of the shock of landing. The tail bumper has just touched, the cockpit hood is open and the engines, apparently, have just been cut. Everything, in fact, seems to be according to the book, so it is not surprising to learn that no one was hurt.

German Gliding Again

AT the request of the Federal Chancellor, the Allied High Commissioner has decided to withdraw "exisiting prohibitions on gliding in the Federal German Republic." Gliding has been permitted for some time in Eastern Germany. This news, incidentally, forms an interesting commentary on a letter, from a German, in our Correspondence columns this week (p. 575).

Old Timer's Day

AT Old Warden Airfield, Biggleswade, Beds, where the Shuttleworth Collection of veteran aircraft and vehicles is housed, a veteran-car rally was held last year, at which the aircraft were on show. Organized by the Veteran Car Club and the Shuttleworth Trust, the event is being repeated this year, and visiting pilots are invited. Sunday, May 20th, is the date.

The Danish Royal Visit

THE Royal Air Force escort for the Danish vessel *Kronprinsesse Ingrid*, in which the King and Queen of Denmark were due to travel to Dover on May 8th for their state visit, was to consist of 18 Meteors from R.A.F. Station, Waterbeach, led by W/C. J. M. Thompson, D.S.O., D.F.C. The Meteors were to meet the ship in the Channel and escort it to a point two miles from Dover harbour. As the ship entered the harbour the Meteors were to fly past in salute at 500ft.

Air Marshal Sir Hugh P. Lloyd, K.B.E., C.B., M.C., D.F.C., A.O.C.-in-C. Bomber Command, was to be among the reception party at Dover, and Air Chief Marshal Sir Leslie N. Hollinghurst, K.C.B., K.B.E., D.F.C., was to be present at Victoria Station on Tuesday afternoon, when Their Majesties the King and Queen were to meet the Danish Royal Party.

Atlantic Flight Broadcast

A 60-MINUTE feature programme on the pioneer Atlantic flight by Alcock and Whitten-Brown in 1919 is to be broadcast by the B.B.C. on June 12th. Lady Whitten-Brown is to take part in it. The logbook carried in the Vickers Vimy bomber was entrusted by its custodians, the Royal Air Force College, Cranwell, to South Wales journalist Harry Green, for the purpose of writing the script. Part of the B.B.C.'s Festival of Britain special programme series, the broadcast is intended to remind listeners that Lindbergh did *not* make the first Atlantic crossing.

Mounting Toll of Migs

ACCORDING to Lt. Gen. E. E. Partridge, Commander of the U.S. Fifth Air Force, 58 Communist Mig-15 jet fighters were destroyed or damaged during April by F-86 Sabres and F-84 Thunderjets. Fifteen Migs had been claimed as definite kills, four as "probables," and 39 as damaged. Ground-attack aircraft, he said, had killed or wounded 10,000 enemy troops during the month; the total number of tactical sorties made was 18,744.

Gen. Partridge described one attack made by an F-80 Shooting Star carrying four 250-lb. bombs. It was unable to drop the bombs—as intended—on a bridge near Pyongkang, but a defect in the release mechanism remedied itself during a strafing attack on 1,000 encamped Communists. Casualties were estimated at 300 killed or wounded.

REPUBLIC ROCKETEER: Eight out of sixteen 5-in rocket projectiles leave a Republic F-84E Thunderjet of the type which has been rendering such excellent support to ground forces in Korea. The F-84E has the new triple-purpose electronic sight, developed by Sperry, which computes for aerial and ground gunnery, rocket firing and bombing.

IN BRIEF

THE de Havilland Aircraft Co., Ltd., have presented a silver trophy to the Northern Heights Model Flying Club for competition at their gala day at Hawkers' Airfield, Langley, on June 24th.

* * *

In conjunction with Marshall's Flying School, Ltd., Shell-Mex and B.P. are providing an aircraft-refuelling service for air visitors to most of the Newmarket race meetings. Marshalls are undertaking air-traffic control there.

* * *

A useful wall-card of linear (in/mm) metric Conversions, *Morganite "Reservoil" Metric Conversion Tables, Ref. SD* 33, has been prepared by the Morgan Crucible Co., Ltd., Battersea Church Road, London, S.W.11.

* * *

In the article "Airport Radio Overseas" it was stated that the I.A.L. synthetic trainer was for the Pakistan Air Force. It is, in fact, for the Civil Aviation Authorities, Pakistan.

* * *

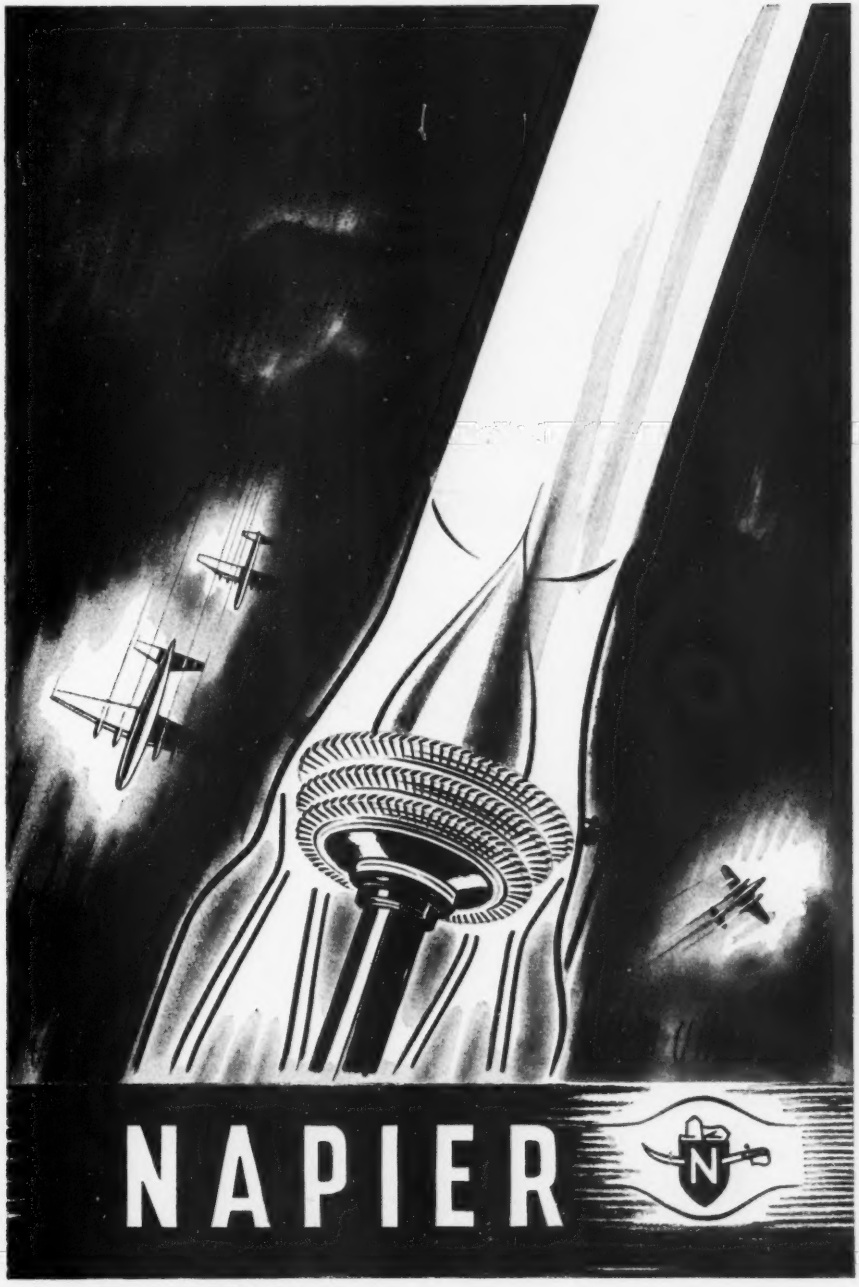
A film on model flying, prepared by the Shell Film Unit in co-operation with the S.M.A.E. and particularly the St. Albans Model Aero Club, has been selected for exhibition in the Telecinema at the South Bank Exhibition.

* * *

Automotive Products Co., Ltd., makers of Lockheed hydraulic equipment, have presented a handsome mermaid-*motif* fountain to the Festival Gardens authorities. It was "christened" at Battersea Park last week by Mr. W. Emmott, Lockheed's managing director.

* * *

Referring to a recent announcement, the Sperry Gyroscope Co., Ltd., state that Sperry instruments fitted in the Hermes IV consist of a type H.L.5 electric gyro-horizon and type C.L.2 Gyrosyn compass. One horizon is fitted on each panel, and there is a stand-by air-driven gyro-horizon between the two pilots' positions.



AERO ENGINES

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C

CASTROL IS RECOMMENDED BY HAWKER AIRCRAFT LIMITED.

Air Commodore Sir Frank Whittle, K.B.E., C.B., M.A., D.Sc., F.R.S., Hon. M.I.Mech.E., F.R.Ae.S., creator of the Whittle turbojet. Sir Frank is seen as a Group Captain, R.A.F.

THE PIONEERS

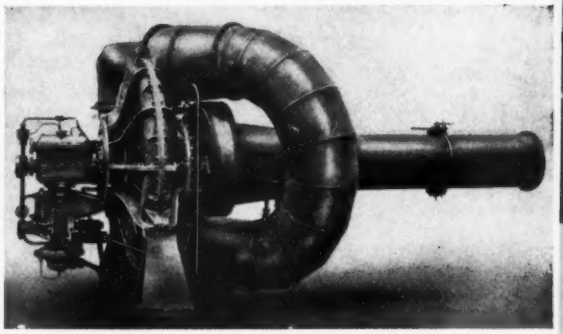
IN the pages which follow it is related how Flight Cadet Frank Whittle was pondering the possibilities of gas turbines and jet propulsion for aircraft as long ago as 1928. It is also recalled that his early efforts were beset with difficulties and discouragements, until, on the evening of May 15th, 1941, he at last saw the little Gloster E.28/39, designed by W. G. Carter and piloted by the late P. E. G. Sayer, rise from the runway at Cranwell. A knighthood and a monetary award are but two expressions of the nation's debt to Air Commodore Sir Frank Whittle (for so he has been known since 1948); but a glance through this issue conveys the extent of our debt. Jerry Sayer is no longer with us, but to his memory, and to the achievements of Whittle and Carter, this page pays tribute.

(Left) F/L. P. E. G. Sayer, O.B.E., sometime chief test pilot, Gloster Aircraft Co., Ltd. Pilot of the E.28/43 on its initial flight. Killed in the air, October 21st, 1942.

(Right) W. G. Carter, C.B.E., F.R.Ae.S., technical director, Gloster Aircraft Co., Ltd. Designer of the E.28/43 monoplane, the first British jet aircraft (May 15th, 1941).

THE SECRET YEARS

An Account of Jet Developments prior to the Official Disclosure in January, 1944

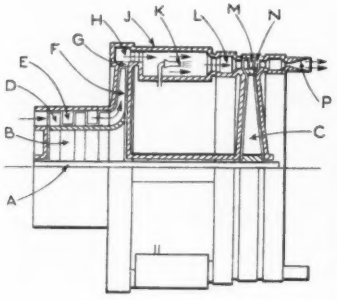


Assembly of the first experimental unit, with a single combustion chamber.

WE have it on the authority of Sir Frank Whittle that he first began to consider the possibilities of gas turbines and jet propulsion for aircraft in 1928, when a flight cadet at the R.A.F. College, Cranwell. Neither the power unit nor the method of propulsion were novel ideas; indeed a number of attempts had already been made to produce the one and to achieve the other, but without success. The early gas turbines were operated at ground level and suffered from low compressor and turbine efficiencies and from materials which enforced a relatively low maximum gas-temperature. Jet-propulsion projects—a number appeared about the end of the first World War—mostly employed a high-velocity jet of gas to induce through a venturi-shaped nozzle a flow of air which enveloped the jet and "augmented" the thrust.

In 1929, when at the Central Flying School, Wittering, Whittle conceived the idea of using the gas turbine in combination with jet propulsion. Hitherto they had been unrelated, but he realized that a number of favourable factors would accrue to such a system. At the low air temperatures obtaining at high altitudes the improved ratio of positive work (expansion) to negative work (compression) for a given maximum gas temperature would yield a substantially improved overall efficiency. Provided operation was affected at high aircraft speeds, some part of the work of compression could be accomplished by ramming the air in a divergent intake duct: by that means the efficiency of the whole compression process would be raised. Finally, not the entire expansion process but only that part necessary to drive the compressor would be subjected to turbine losses.

A patent application was lodged on January 16th, 1930, and it is of interest to note that in addition to the turbojet a claim was made for a ramjet. This, however, was disallowed by the Examiner on the grounds of anticipation by other inventors and was, perforce, deleted. The specification was brief and, in the customary legalistic phraseology, the declared object was: "obtaining propulsive force in the one sense of direction by the reaction caused by expelling fluid in the opposite sense of direction." It expressed the conviction that "an embodiment of this invention will provide a large thrust in proportion to its weight, that it will perform at greater altitudes than are at present obtainable, that it makes possible higher speeds than have up to the present been obtained, that it will operate with any fuel now in use, and that it will have a reasonably low fuel consumption. Further, that simplicity and convenient external form is achieved."



The first Whittle patent, 1930.

A—Shaft.
B—Compressor rotor.
C—Turbine rotor.
D—Compressor rotor blades.
E—Compressor stator blades.
F—Centrifugal impeller.
G—Diffuser vanes.
H—Air collector.
J—Combustion chambers.
K—Fuel sprayer.
L—Gas collector.
M—Turbine stator blades.
N—Turbine rotor blades.
P—Jet nozzles.

Quoting again, it was stated "it can be demonstrated that the efficiency of this device conceived as a propulsive engine will not be reduced by reduction of the density of the atmosphere, and owing to the low temperature of the upper atmosphere may actually be enhanced."

The first approach was the obvious one—it was to the Air Ministry, and there began the series of rebuffs and discouragements. In the same year, 1930, a number of attempts were made to enlist the support of engineering firms. The verdict was always the same— the practical difficulties were too great, the gas turbine was unproved, there were prospects of substantial advances in the conventional piston engine. Regrettable as it was, this attitude is understandable in view of the prevailing conditions. Known turbines and rotary compressors were of low efficiency, technicians were pessimistic regarding improvements, and industry was undergoing a period of depression. Hope of ever reaching the stage of practical development receded, but Whittle retained his faith and never ceased to study and design on paper. A minor tragedy of this discouraging period was the lapsing of the original patent. As a result of failing to arouse any interest in the idea the necessary renewal fees were not paid.

Financial Support

Whittle specialized as an engineer officer and, while taking a course at Cambridge in 1935, was contacted by two ex-R.A.F. officers, R. D. Williams and J. C. B. Tinling, who considered that another attempt should be made to launch the project. An agreement was concluded and immediate efforts were made to obtain financial backing. After initial lack of success they secured the interest of an independent consulting engineer, M. L. Bramson, on whose technical opinion—differing from current orthodox disbelief—the investment-banking firm of O. T. Falk and Partners agreed to lend their support. A sum of £2,000 was subscribed for working expenses and forthwith an order was placed with B.T.H. for engineering and design work to Whittle's requirements for a first experimental unit.

Negotiations proceeded for the formation of a company, Power Jets, Ltd., and as Whittle was a serving officer of the R.A.F. the project came under the examination of the Air Ministry. Even at that date the Ministry deemed it unlikely that the suggested power unit would be of military value and consequently decided there was no need to impose secrecy. However, in March, 1936, an agreement between Whittle, Williams and Tinling, the President of the Air Council, and O. T. Falk and Partners established the new company. A contract was placed with B.T.H. to build the compressor and turbine and another with Laidlaw, Drew and Co. of Leith, for the combustion equipment.

Here must be emphasised one of the most difficult hurdles that Whittle had to surmount. His designs and his estimates of performance were based solely on aerodynamic theory, yet at that time techniques for rotary compressors and turbines, although well established, were based on empirical rules and experimental precedents. He was breaking new ground and had to refute long-cherished traditions; to win first the confidence and then the support of the acknowledged experts. Up to that time the highest efficiency attained by a centrifugal compressor was about 68 per cent with a pressure ratio of about 2.5 : 1. As a minimum, Whittle expected 70 per cent efficiency but with a pressure ratio of 4 : 1. This, it was felt, and stated, was asking too much. How right he was became evident when eventually the Whittle compressor

achieved a 4 : 1 pressure ratio with an efficiency of 72 per cent.

Somewhat similar difficulty was encountered with the turbine. Whittle's calculations could not be reconciled with the best established practice. Both sides rechecked their calculations and both were reassured they were correct. Whittle explained his were based on the aerodynamic theory of the free vortex, giving a pressure difference along the radial length of the turbine blade. This was regarded as sheer heresy, as turbines had always been designed on the assumption of a uniform pressure along the blade. Whittle, however, proved his case and revolutionized design.

Despite the necessity to surpass all previous engineering experience in the compressor, the combustion equipment and the turbine, the highly desirable individual development of components was precluded as too lengthy and costly a process in view of the company's limited resources. The decision had to be made to build a complete proving engine. While work proceeded on the compressor and turbine, experiments were conducted at the B.T.H. works with combustion apparatus supplied by Laidlaw, Drew and Co., and testing of the complete unit began on April 12th, 1937. It continued until August of that year when, the lessons having been learned, modification and reconstruction were decided upon. An element of danger was involved in testing and accordingly it was deemed advisable to discontinue running at Rugby and B.T.H. leased premises at Lutterworth for the purpose.

Initial Success

By this time the Air Ministry, on the advice of the Aeronautical Research Council, awarded contracts to Power Jets, Ltd., for further research as a "long-term" project. This changed the course of events, as strict secrecy was then imposed, in accordance with established practice in such matters. Tests on the reconstructed engine were commenced at Lutterworth in April, 1938, but difficulties were encountered with combustion and in May the unit was damaged by failure of a turbine blade.

Once again it was modified and rebuilt. The third version was under test intermittently from October, 1938, to February, 1941, when it was wrecked by turbine failure. (This actual unit, in its wrecked condition, is a prominent exhibit in the aircraft engine section at the Festival of Britain.) During this period the combustion difficulties were resolved, mainly by means of assistance from the Shell Petroleum Company's Technical Department under I. Lubbock—whose retirement, incidentally, was announced three weeks ago. He developed an atomized-spray burner—earlier efforts had been with vaporizing burners—and also a more satisfactory sheet-metal combustion chamber. Shell also loaned to Power Jets for two years J. R. Joyce (now prominent at Thornton Laboratory) to assist with burner and fuel problems.

The relative success of these trials caused the Air Ministry to change its view and to regard the project as the basis of a practicable propulsion unit. Accordingly, it awarded contracts to Power Jets for a flight engine on July 12th, 1939, and to the Gloster Aircraft Co. for an experimental jet aircraft on August 30th, 1939.

The power unit, designated the W1, was sub-contracted to B.T.H., but during building certain of the components were deemed to fall short of specified requirements. These parts formed the basis of the first experimental flight engine W1X, which was assembled and tested while the W1 was being completed. When W1 was delivered some modifications arising from experience with W1X were embodied, and after a few preliminary runs it successfully passed a 25-hour special-category test on April 12th, 1941, clearing it for flight. By this time the Gloster E.28/39 aircraft had been completed and the W1X unit was installed for taxying trials. During one of these trials the aircraft actually left the ground in a brief, straight hop.

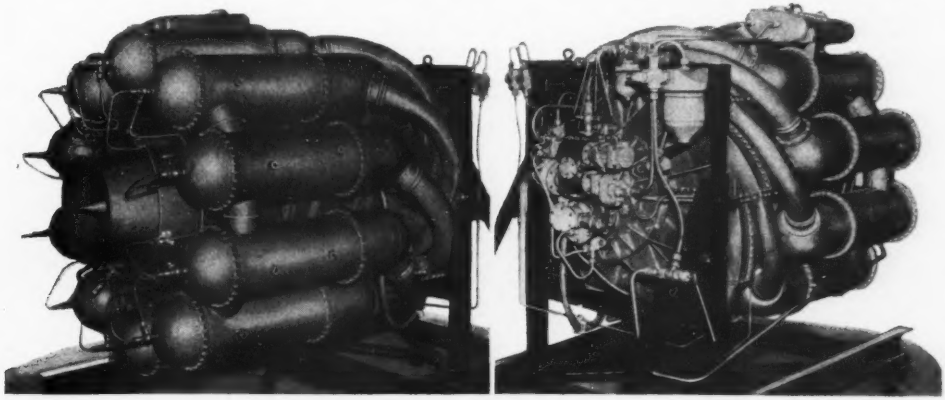
The W1 engine was passed for ten hours flying and was duly installed. Commencing on May 14th, 1941, the full programme of flight trials by test pilot P. E. G. Sayer was completed in a fortnight without incident. That fact speaks volumes for the elaborate care and foresight lavished on the project prior to the trials. The method used was on the following lines. A series of informal "post-mortems" was held, at which a combination of possible circumstances was envisaged and the probable effects investigated and discussed. An example will illustrate the procedure. The question was posed as to what would happen if, after a run at high speed, the power unit was voluntarily or involuntarily cut. As the strength of the long, sheet-metal tailpipe was materially lowered at the operating temperature could it then support the 5lb-sq. in pressure in the fuselage? (This point is explained in the next paragraph.) Doubts were expressed, a test was made, and the tailpipe collapsed. A redesigned pipe with peripheral stiffening ribs withstood the test and was installed.

It is not generally appreciated what an outstanding aircraft the Gloster E.28/39 was, and how brilliantly W. G. Carter and his team solved the problems presented by this entirely new type. It was the first turbine-driven aircraft and also the first to be jet-propelled. Lacking an airscrew, there was obviously no slipstream for the control surfaces. As the jet unit was enclosed in the fuselage due allowance had to be made for a not inconsiderable extension of fuselage length, resulting from expansion under operating thermal conditions. It was the first British single-seater aircraft to be equipped with a tricycle undercarriage, and this was the first occasion on which the single-leg undercarriage was used. The Dowty Equipment Company of Cheltenham had a hand in this. It can well be claimed to be the first pressurized British aircraft, since the after half of the fuselage served as a plenum chamber for the power unit and was therefore under about 5 lb-sq in pressure when in flight. It was the first British aircraft to be equipped with an automatic observer; i.e., built-in photographic-recording apparatus with push-button control. Finally, although specified for a maximum speed of 450 m.p.h. it exceeded that figure by more than 50 m.p.h.

The successful trials metamorphosed the situation. The Ministry of Aircraft Production decided to plan the production of a Whittle turbojet and the Gloster F9/40, the Meteor, a new fighter with twin jet units in wing nacelles. In July, 1941, under the wartime technical collaboration arrangements, a full disclosure was made to Gen. Arnold of the U.S. Air Force. He arranged for a Liberator bomber to be sent from America and the W1X unit, a full set of drawings of a later version, the W2B, and a small team of engineers were flown over.

The Americans are fast workers. In September, 1941, the W1X was delivered to the General Electric Co., and an order was placed with the Bell Aircraft Co. for a twin-jet aircraft. Only twelve months later, on October 1st, 1942, the first American-built turbojet made its maiden flight. Typical of the measures taken to preserve secrecy at the time is the stratagem used when the Bell

The W1 unit with reverse-flow combustion chambers was the first flight engine. It is now preserved in the Science Museum, South Kensington.



THE SECRET YEARS . . .

airframe was transported by road to the installation airfield. An airscrew was mounted temporarily on the nose of the fuselage to give the impression that it was conventional type!

Reverting now to 1939, we may trace the chequered history of production. B.T.H. built the W1X, W1, the W1A with redesigned blading and no water-cooling system, also flown in the E.28/39, and a more advanced unit, the W2. In passing it may be recalled that the first four units, all built by B.T.H., are still in existence. The first experimental model is held by Power Jets, Ltd., and, as already mentioned, is in the Festival Exhibition; W1 is preserved at the Science Museum, South Kensington; W1X at the Smithsonian Institute in the United States; and W1A at the R.A.F. College, Cranwell.

During the 1939-40 period, in view of the rapidly mounting demands for Service aircraft, it is understandable that considerable weight of opinion was expressed against what appeared to be a diversion of effort. At one time it seemed that work would be stopped and development postponed until some later and less hazardous period. It must be recorded that Sir Henry Tizard, of the Aeronautical Research Council, thoroughly appreciated the potentialities of the turbojet, and it was largely as a result of his insistent advocacy that work was continued without serious interruption.

Industry was still undergoing reorganization and reorientation for war purposes, and production of W2 units was transferred to the Rover Co. in 1940. The Rover version of the W2, termed by them the B23, had the usual reverse-flow combustion system. Some difficulty was experienced in fabricating these combustion chambers and later the Rover Co. built the B26, the first unit having straight-through combustion chambers. Combustion had been one of the most intractable problems, and in 1940 Whittle had made designs for two units, the W2Y and W3X, with straight-through systems. These designs antedated all the others.

Early Production

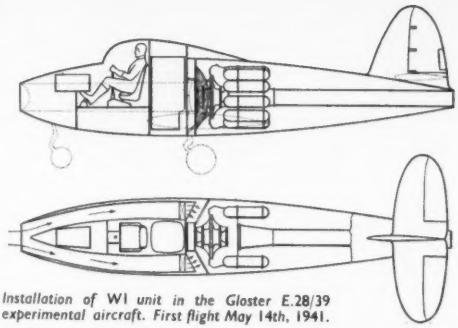
Air Marshal Tedder had planned for the B23 to be produced by the Rover, Vauxhall, and B.T.H. companies and Power Jets spent three months in briefing these firms. However, Vauxhall were eventually required to concentrate on road vehicle and tank engines, B.T.H. resources were claimed for some other activities and only Rover, who started factories in old cotton mills at Clitheroe and Barnoldswick in Lancashire, were allowed to continue. Subsequently, the exigences of the war situation led to Rover being redirected to produce tank engines and to turbojet production being switched to Rolls-Royce. The Derby firm had already acquired some experience by building, under contract from Power Jets, an experimental low-pressure Whittle unit, the WR1—and, of course, they possessed unrivalled knowledge of the operation of supercharging compressors at altitude.

Rolls-Royce produced a reverse-flow unit, the Welland, based on the Rover B23. This was the first use of the River designation so aptly applicable to a unit producing a smooth, continuous flow of power. Thereafter came the Derwent and Nene straight-flow units which went into full production and service.

In a brief summary of a development of such magnitude it is impossible to give credit to all the individuals, firms and organizations contributing in some measure at some stage to the final success of the project. Mention must be made, however, to the long and valued research on axial compressors by Hayne Constant and A. A. Griffiths, at Farnborough. This exercised great influence on the design of the Metrovick F.2 and Armstrong-Siddeley A.S.X axial flow turbojets. Other aircraft engine builders were also developing their own turbine units. In 1941 Major Halford designed the de Havilland Goblin turbojet which was first run on April 13th, 1942, and first flown, in a Gloster Meteor, on March 5th, 1943. Bristol and Napier each developed turboprop units, the Theseus and Naiad respectively.

The aid of very many firms was enlisted in component manufacture and development. The writer has a list, admittedly not exhaustive, of more than eighty concerns. Apart from the Shell Petroleum Co., already mentioned, a number of other firms participated in the development of the fuel combustion system. C.A.V. undertook production of burners, the Plessey Co. of fuel pumps and Ricardo and Co.—who throughout acted as consultants on combustion problems—of control equipment. During the period of production by Rover, the Lucas Co. of Birmingham was brought in to build the sheet-metal components, combustion chambers, and tailpipes, and subsequently it developed the complete range of pumps, burners and controls which eventually became standard equipment on the Rolls-Royce Derwent and Nene units, and later on certain others.

For combustion experiments, the outstanding need was always compressed air. In the early days, Power Jets obtained permission to make use of a large compressor which had been installed at Dartford in connection with the boring of the Thames Tunnel,



Installation of W1 unit in the Gloster E.28/39 experimental aircraft. First flight May 14th, 1941.

work on which had been suspended during the war. They took their components down to the site and tested in a shed. Later, Lucas required a compressor for their combustion experiments and, typical of the enlightened co-operation of the authorities at that time, were allowed to take the stand-by compressor at Dartford and transport it to the factory they had set up in Lancashire.

For testing compressors air was required on an even larger scale, and at one period compressor tests were conducted at the Bedford Power Station by running the stand-by steam-turbine set, to the dismay of the station engineers and the mystification of the local residents. This arrangement served in the interim whilst the necessary manoeuvres were conducted to divert a Le Mont boiler, intended for a destroyer, to Whetstone, where the English Electric Co. had installed a steam turbine for a specially designed compressor test station.

While acknowledging Air Commodore Sir Frank Whittle's inventive genius, his pioneering spirit and his consumate skill as an aerodynamicist, it must not be forgotten that he was also an outstanding pilot. When drafted to the C.F.S. at Wittering in 1929, he had already established a reputation as a fighter pilot on Siskins with No. 111 Squadron at Hornchurch. At the Hendon Displays in 1929, 1930 and 1931 he was chosen to give exhibitions of crazy flying.

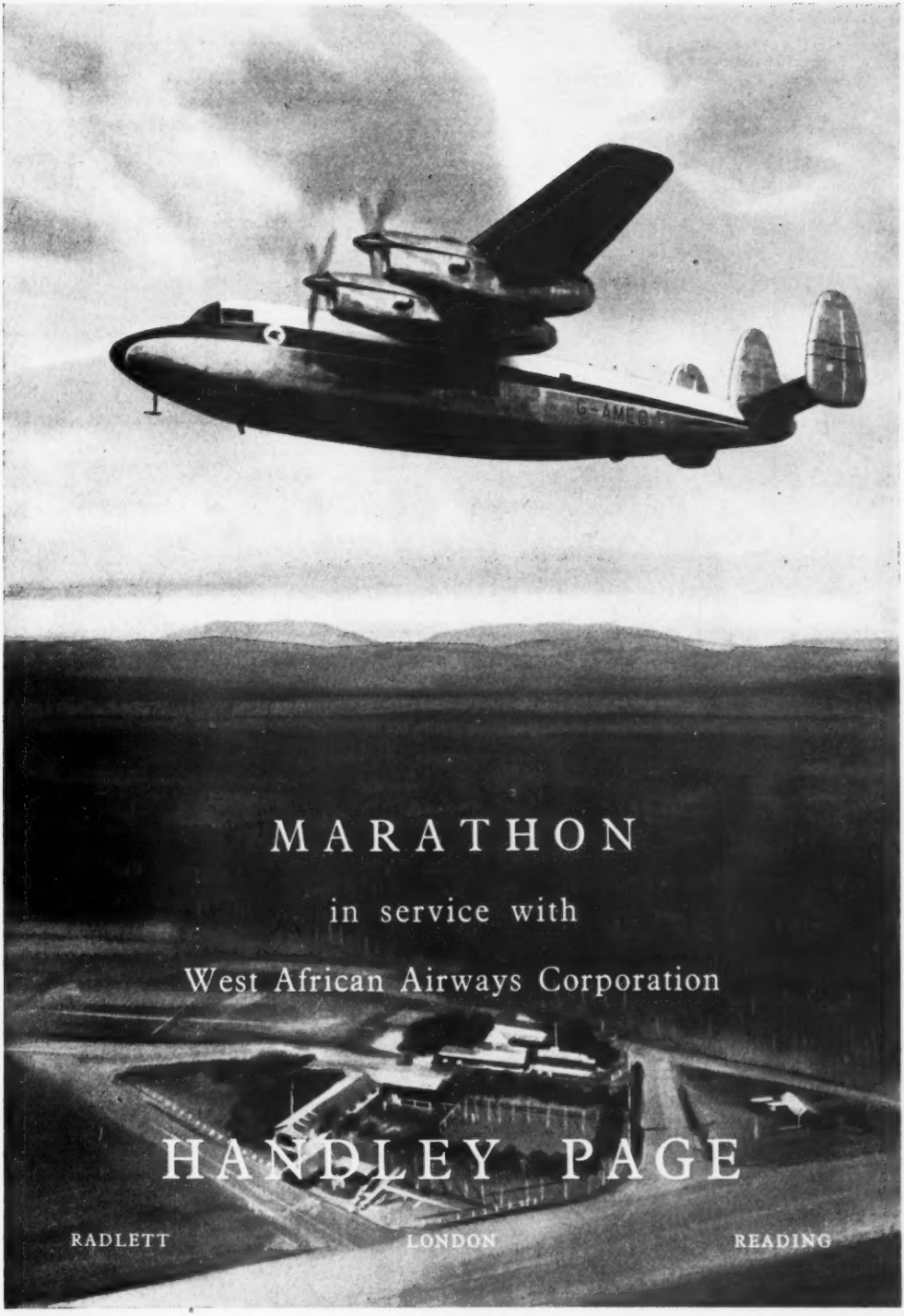
He logged many hundreds of hours as a test pilot. Between 1930 and 1935 he made many of the test flights for Melvill Jones' investigation of boundary-layer phenomena—the early tufting experiments. Later he conducted a long series of tests on catapulting from the *Ark Royal* on a Fairey 3F floatplane.

It was at C.F.S. that the long association of Whittle with W. E. P. Johnson commenced. Johnson was serving as an instructor and himself achieved fame as the first man in the world to make—in April, 1931—a solo "blind" take-off and later to complete a full programme of aerobatics solely on instruments. He had been trained as a Patent attorney and, enjoying the confidence of Whittle, helped him draft his early patents. He joined Power Jets soon after its formation, supervised the installation of the W1 engines in the Gloster E.28/39 and is now managing director of Power Jets (Research and Development), Ltd., the company holding the nationally-owned patents in the gas-turbine field.

It is not too much to claim that these early years have changed the course of events. They have revolutionized aircraft design and altered all earlier conceptions of speed of transport. They mark not merely a progressive step but a giant stride forward—literally a phase change. The struggle to win recognition and support is, perhaps, familiar. The relatively short period in which the projects were realized and the prophecies fulfilled, and surpassed, is truly remarkable. A new industry has been built up which has already won a prominent position in our vitally important export programme. Sir Frank Whittle and these early years are assured their place in history.

The claim that the Gloster E.28/39 with Whittle W1 turbojet made the first successful jet-propelled flight cannot be controverted, although both Germany and Italy had demonstrated the possibility earlier. On August 27th, 1939, the day Germany moved into Poland, a Heinkel 178 powered by a simple turbojet designed by H. von Ohain was flown, but crashed in about fifteen minutes. The sponsors were discouraged, war requirements intervened, and it was not until July 18th, 1942, that the Messerschmitt 262 flew on two Junkers Jumo 004 turbojets. In Italy, S. Campini propounded a system of jet propulsion in which a conventional piston engine was used to drive the compressor. The airflow took up the heat radiated from the engine, the exhaust gases were added, and finally liquid fuel was burnt in the tailpipe, somewhat in the manner of an afterburner. A special Caproni aircraft, C.C.2, equipped with this system was flown for ten minutes on August 27th, 1940. More than a year later, on November 30th, 1941, a much-modified version of the C.C.2 was flown from Milan to Rome, with a stop of unspecified duration at Pisa, in two and a half hours. It was reported to be undergoing tests at Guidonia research station but nothing further was heard of it.

F. C. S.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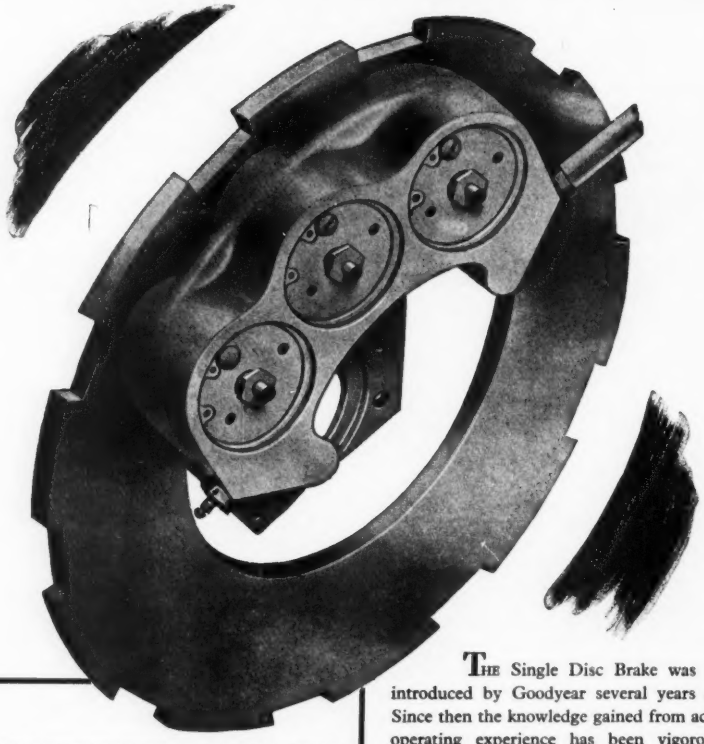

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Britain's Turbine Aircraft

Their Development and Present Status

IN surveying the numerous types of British aircraft which, during the past ten years, have flown wholly or partly with turbine power, it is expedient to segregate them under the headings of research, military and civil. This will facilitate the tracing of their progress and give a clearer view of the present scene.

It will be noted that in the research and development field Britain has pursued a courageous course in constructing aircraft of unorthodox configurations, though with some regret it must be recorded that none of these has yet achieved sonic speed in level flight. Nevertheless, that we should already be flying three different aircraft of delta form is reassuring evidence of forward thinking.

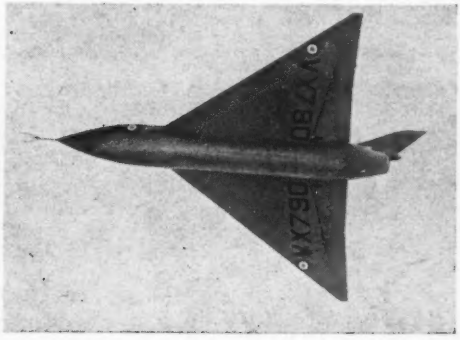
The military picture is to some degree clouded by the changeful conditions of rearmament. In certain classes we may be at some disadvantage (e.g. there is as yet no multi-seat, multi-jet, all-weather fighter in this country to match the Avro Canada Canuck); but there is no reason to doubt that secret types now under construction or development will render full value for the research effort which has paved their way. The English Electric Canberra—accorded the signal honour of being adopted by the U.S. Air Force—gives a foretaste of the qualities which are being built into our new four-jet bombers.

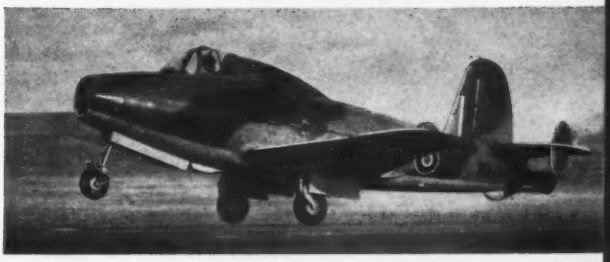
On the civil side the picture is especially bright. The de Havilland Comet is unchallenged and will continue so for a considerable period. It is the highest expression of British foresight, determination and technical skill. The qualities of the turboprop airliner—typified by the Vickers-Armstrongs Viscount, Armstrong Whitworth Apollo and Handley Page Hermes 5—are the envy of the world, and though hundreds of hours' flying have been amassed by these and similar aircraft in this country, the first American "Turbo-Liner" has only recently taken the air.

The above facts are not set down in any spirit of bombast, or to belittle the efforts of other nations, but in token of the diligence with which the visions of F/Cdt. Frank Whittle have been transposed into reality by his own countrymen.

Elsewhere in this issue some account is given of the turbine power plants of other nations and of aircraft in which they are installed. Among these machines is a swept-wing bomber, at present unique, but soon to be challenged by British four-jet machines designed for longer range and greater bomb capacity than the Canberra.

Avro 707B delta-wing research aircraft (Rolls-Royce Derwent).





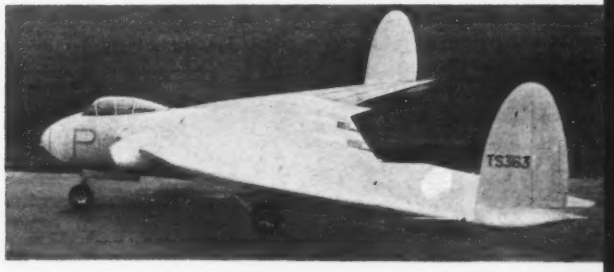
Comparative studies of Gloster E.28/39 (top) and Trent-Meteor.

RESEARCH AIRCRAFT

LOGICALLY under this heading (although the design was based on intercepter requirements) comes the archetype of all British turbine-powered aircraft—the Gloster-Whittle E.28/39. This historic little single-seater left the ground for short hops during taxying trials in April, 1941, but the first official flight was from Cranwell, at 7.40 p.m. on May 15th, 1941. The pilot was the late P. E. G. Sayer. Within a fortnight 10 hours' flying had been logged.

Two E.28s were built and were flown with various power plants. The most powerful unit installed was the W.2/700, and with this a speed of 505 m.p.h. was recorded at 30,000ft.

(Above) D.H.108 and altitude-record Vampire. (Below) A.W.52.



Like the Vickers-Armstrongs Tay-Viscount above, the Avro Ashton (right) is being used to establish techniques and the behaviour of equipment.

RESEARCH AIRCRAFT . . .

On June 24th, 1943, a height of 42,170ft was attained. A final 10-hour testing programme was undertaken in 1944, and in April, 1946, the machine was housed in the National Aeronautical Collection.

Since the brave days of the E.28 Britain's turbine-powered research aircraft have been of two sorts : first, the machines specially designed for aerodynamic research and typified by the A.W.52, D.H.108 and three delta-wing types; second, those adapted military and civil machines used for power-plant investigations and for the study of operational techniques.

Earliest of the specialized machines for aerodynamic research was the D.H.108, the first prototype of which made its maiden flight—in the hands of the late Geoffrey de Havilland—on May 15th, 1946. Three examples were built and were the means of amassing a precious store of knowledge on the behaviour of semi-tailless aircraft and swept-back wings at high Mach numbers before each, in its turn, met with disaster.

The "108s" were followed by two prototypes of an equally remarkable machine of tailless design—the Armstrong Whitworth A.W.52. The first "52," with two Rolls-Royce Nenes, first flew on November 13th, 1947; the second, with two Derwents, on September 1st, 1948. These machines were built for the study of design characteristics of much larger tailless machines for civil and military work.

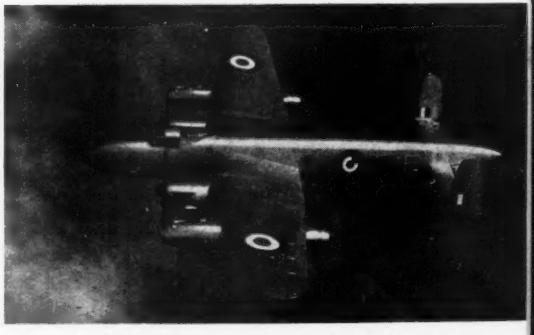
The tailless configuration, of course, is relatively old; but the delta form is one which stems directly from jet propulsion, for only the gas turbine or rocket offers the thrusts necessary to make it worth while, its merits being manifest chiefly in the transonic regime of flight.

Britain's first delta was the Avro 707A, which first flew on September 4th, 1949. Having appeared at the S.B.A.C. display of that year, it was subjected to a programme of flight trials during which it was destroyed in a crash. Construction of a second 707 was, however, already in hand and this machine emerged last year as the 707B. Its first flight was on September 6th, and by mid-December it had more than a hundred flights to its credit. W/C. R. J. Falk reported "easy and pleasant" flying characteristics. On October 6th, 1950, S/L. R. H. Smythe made the first flight of the Boulton Paul P.111 Nene-powered delta aircraft, and on March 12th this year the Fairey F.D.1, of somewhat similar configuration, was taken up for the first time by G/C. R. Gordon Slade.

Conversions of piston-engined airliners to jet power (solely for research flying) are the Vickers Nene-Viking and Tay-Viscount, and the Avro Tudor 8 and Ashton, both with four Nenes. The following are representative flying test-beds : Gloster Trent-Meteor (the first turboprop aircraft to fly—in September, 1945); Welland-Wellington; Lancasters and Lancastrians with one or more Nenes, Ghosts, Darts, Mambas, Pythons, Avons and Sapphires; a Hastings with Sapphires; Lincolns mounting the Naiad, Theseus and Proteus; and Meteors with Avons and Sapphires.

One of the most significant achievements by a research aircraft was Mr. John Cunningham's attainment of the world's record height of 59,492ft in a special Ghost-powered D.H. Vampire on March 23rd, 1948.

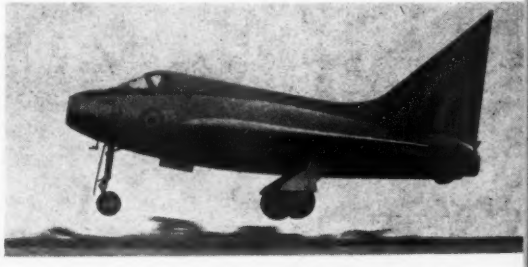
The experimental Gloster Meteor with two Rolls-Royce Avon turbojets.



Representative of British flying test-beds is the Sapphire-Lancastrian above.

Fairey F.D.1 delta research aircraft, powered by a Rolls-Royce Derwent.

The delta-winged Boulton Paul P.111 (below) has a Rolls-Royce Nene.



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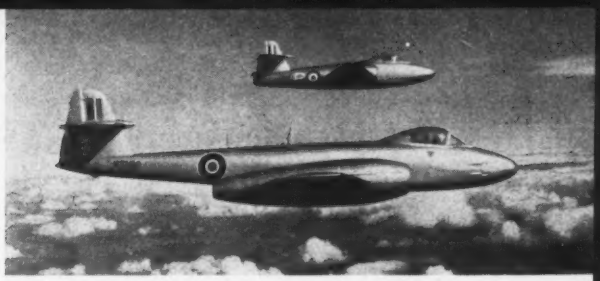
The D.H. Venom F.B.1 is a Ghost-powered Vampire development.

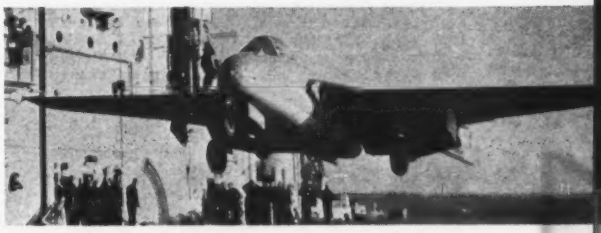


Nearer the camera is a Gloster Meteor 8; beyond, the E.1/44.

MILITARY AIRCRAFT

THE development of Britain's turbine-powered military aircraft may conveniently be traced with reference to the companies concerned, starting with Gloster, to which firm goes the credit for producing our first jet fighter. This was the twin-jet F.9/40, the prototype of the Meteor, which first flew in March, 1943. Rover, Rolls-Royce, Metrovick and Halford units were installed. The Meteor 1 (June, 1944) had Wellands and was used against the German flying bombs. The improved Mk 3 was succeeded in R.A.F. service by the Derwent-powered Mk 4, especially notable for its rate of climb; in its turn this mark is giving way to the present Mk 8, with increased endurance and improved handling qualities. The Mk 7 is a two-seater trainer, the Mk 9 a fighter/reconnaissance aircraft, the Mk 10 a high-altitude photographic reconnaissance machine, and the Mk 11 a two-seater night fighter, developed by Armstrong Whitworth. Latest of the family is a P.V. ground-attack version, capable of carrying many alternative loads, including four 1,000 lb bombs. Gloster have also built examples of the single-Nene E.1/44. These are being used for research.

Chronologically, Britain's second jet fighter was the de Havilland Vampire, a twin-boom, single-Goblin machine with excellent handling qualities. The first Vampire flew on September 30th, 1943, and in the spring of the following year 500 m.p.h. was exceeded for the first time by any aircraft in level flight. Fighter, fighter/bomber, night fighter and trainer Vampires have been delivered in numerous marks to meet large domestic and export orders. In December, 1945, a Sea Vampire became the first jet-propelled aircraft to



First carrier take-off by a jet aircraft—a D.H. Sea Vampire.

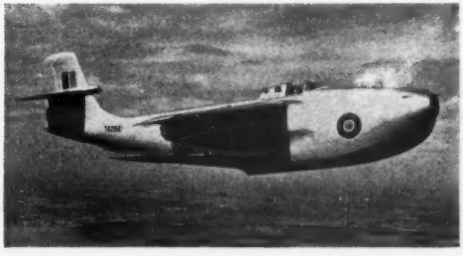
Deck trials of Vickers-Supermarine Attacker naval fighter (Nene).

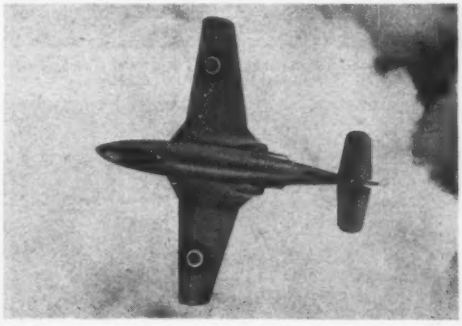
Vickers-Supermarine 535 experimental fighter (Rolls-Royce Nene or Avon with afterburner).

Hawker P.1081 Nene-powered experimental swept-wing fighter.

Hawker Sea Hawk (Rolls-Royce Nene), adopted by the Royal Navy.

Two Metropolitan-Vickers Beryls power the unique Saunders-Roe S.R./A.1 fighter flying boat, a recent view of which appears below.



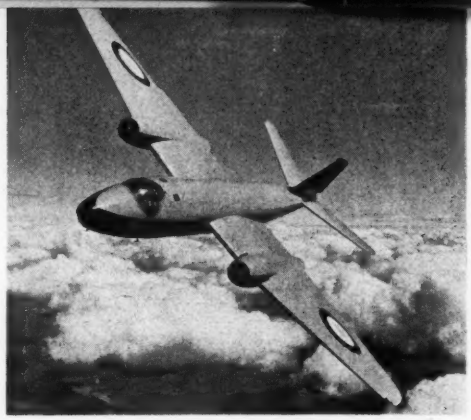


MILITARY AIRCRAFT . . .

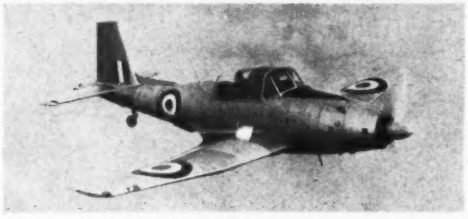
land on and take off from the deck of an aircraft carrier.

Successor to the Vampire is the Ghost-powered Venom, with a totally new wing and a marked superiority in all aspects of performance. Several variants are being developed, and the Sea Venom all-weather fighter has lately been adopted by the Royal Navy.

The Supermarine company's entry into the field of jet propulsion was on July 27th, 1946, with the first flight of the Attacker, a single-Nene fighter using major components of the piston-engined Spiteful. A "navalized" version of this type is now in production. An experimental development, with back-swept wing and tail surfaces, was the 510; this retained the tailwheel undercarriage of the Attacker and was



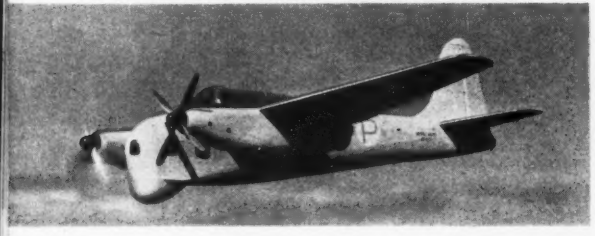
Pre-eminent light bomber—the English Electric Canberra (two Rolls-Royce Avons). Adopted by Gt. Britain, Australia and America.



The Boulton Paul Balliol I was an experimental Mamba-powered trainer.

Westland Wyvern T.F.2 strike fighter, with Armstrong Siddeley Python.

(Above) *Fairey 17 anti-submarine aircraft (Armstrong Siddeley Double Mamba); (below) Short S.B.3 (two Mambas).*



the first swept-wing jet aircraft to operate from an aircraft carrier. A yet later development is the 535, with nosewheel undercarriage and re-designed wing and fuselage, and having provision for afterburning for its Nene turbojet. The installation of a Rolls-Royce Avon is foreseen for an even newer development of this type.

Hawker's jet debut was made on September 2nd, 1947, with the straight-winged P.1040, characterized by a bifurcated trunk-pipe for its single Nene. A carrier-borne development, the Sea Hawk, is in quantity production for the Royal Navy. Basically the same aircraft, but having a swept-back wing, was the P.1052, which, on May 13th, 1949, flew from London to Paris in just over 21 minutes, though this achievement gave no real indication of its ultimate speed. The latest announced development is the "all swept" P.1081, with tail outlet for the Nene, allowing the installation of an afterburner.

Britain's first jet bomber is the English Electric Canberra, the B.1 prototype of which was first airborne on May 13th, 1949. The Canberra is scheduled for large-scale production, not only at several factories throughout this country, but in the U.S.A. also. British Canberras will have Rolls-Royce Avons, but those constructed in the U.S.A. may have American-built Sapphires.

The first purely military aircraft to fly with a turboprop was the Mamba-powered Boulton Paul Balliol advanced trainer (March 24th, 1948). A Mamba was also installed in an Avro Athena to the same specification.

For naval flying the turboprop offers manifold benefits. The Double Mamba is installed in the Fairey G.R.17 anti-submarine aircraft (ordered in quantity by the Royal Navy) and in the comparable Blackburn Y.B.1. The Short S.B.3, likewise for carrier-borne anti-submarine operations, has two Mambas. For strike/fighter duties the Python-powered Westland Wyvern T.F.2 is on order.

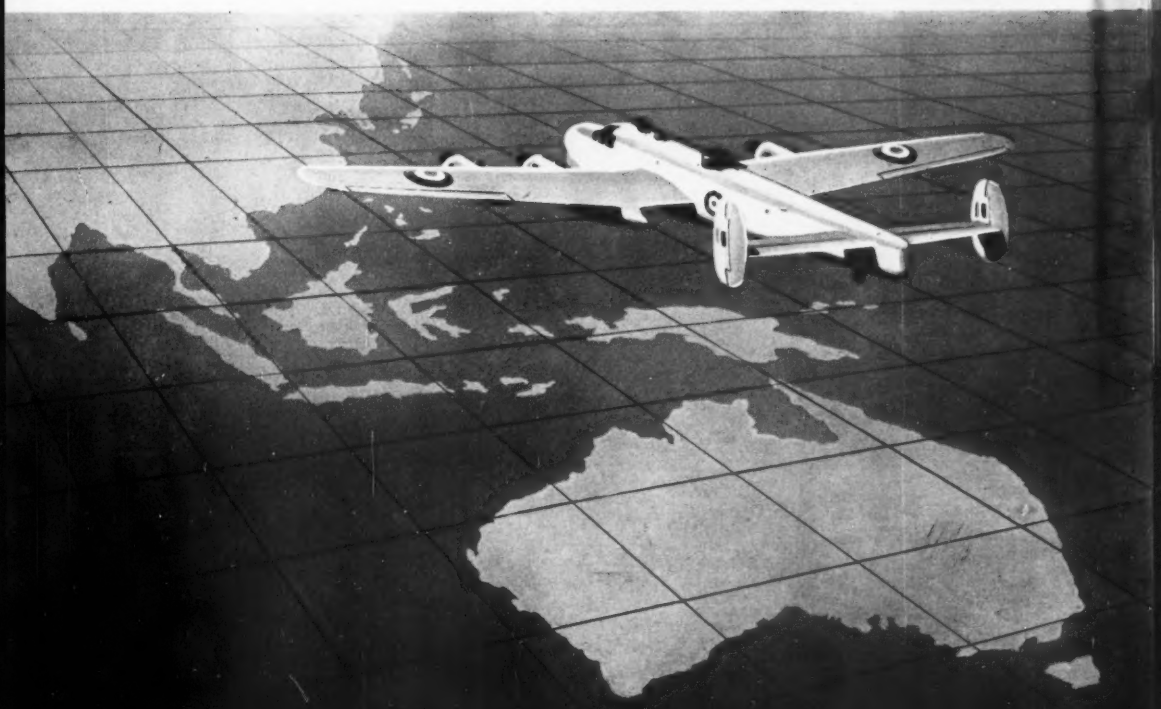
Blackburn Y.B.1 carrier-borne anti-submarine aircraft (Double Mamba).

The sea, it is said, is a natural defence

so long as you have **COMMAND OF THE SEA**

It is true that an insular nation has a great natural barrier against a potential enemy, but those whose task it is to maintain a constant vigil over the weary miles of sea have an arduous and a hazardous duty. Yet the spacious layout of the land-based Avro Shackleton with its galley facilities and its four engines—so essential for maritime reconnaissance aircraft—enables its crew to patrol in comfort and to return to base free from fatigue. Its powerful offensive armament, its low level manœuvrability and its capacity for carrying large and varied loads to extreme ranges combine to make the Shackleton a formidable attacker.

AVRO *Shackleton*



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DE HAVILLAND

D·H AIRCRAFT

D·H ENGINES

D·H PROPELLERS

Vickers-Armstrongs Viscount 700, with four Rolls-Royce Dart turboprops.

Britain's Turbine Aircraft . . .

CIVIL TYPES

THE first *bona fide* British transport aircraft to fly with turbine power was the prototype Vickers-Armstrongs Viscount 630, which, with four Rolls-Royce Dart 1 turboprops, made its initial flight on July 18th, 1948. From the start, performance and handling gave the greatest satisfaction, while the absence of vibration and low noise-level inherent in the turboprop airliner were the subject of enthusiastic comment by everyone fortunate enough to fly in the machine, even in its undeveloped state. On July 29th, 1950, the Viscount 630 made the first commercial flight by a turbine aircraft when it flew fare-paying passengers on the Northolt-Paris service of British European Airways. By the end of August 730 hours' flying had been logged.

Attainment of this figure more or less coincided with the maiden flight of the larger and generally more efficient Viscount 700, on August 28th. Aircraft of this series have been ordered by B.E.A. and Air France. The B.E.A. model (Viscount 701) will go into service next year and will carry 40 passengers in the pressurized cabin. Cruising speed on 80 per cent power, at 18,000ft, is quoted as 338 m.p.h.

An airliner of the same character as the Viscount is Armstrong Whitworth's Apollo, first flown on April 10th, 1949, and powered with four Armstrong Siddeley Mambas. A Certificate of Airworthiness was awarded on January 1st this year and a start has been made on a programme of overseas flights. For short and medium-range work the Apollo offers cruising speeds up to 306 m.p.h. Typical accommodation is for 31 passengers and some 10,000 lb of freight. The second Apollo, now under construction, is likely to be fitted with the new and highly efficient Mamba ASM. 3 turboprops. Maximum take-off weight will be 45,000 lb.

Handley Page are developing two types of turboprop airliner for widely differing duties. The first—the Hermes V, with four Bristol Theseus—is what might be termed a mainliner, while the second—the Mamba-powered Marathon—is for feederline work.

The maiden flight of the first prototype of the Hermes V was on August 23rd, 1949; the second, with double-slotted trailing-edge flaps, flew last year and, with its speed and manoeuvrability, made a deep impression at the S.B.A.C. display. The latest figures show a gross weight of 90,000 lb, a take-off run to 50ft of 1,100 yd, and a cruising speed of 350 m.p.h. at 24,500ft. At this speed, with a 17,000-lb payload, the range is 1,500 miles.

Just as the Hermes V is a direct development of the piston-engined Hermes IV as operated by B.O.A.C., so the Marathon II is related to the four-Gipsy Marathon I. It first flew on July 21st, 1949, and has proved capable of maintaining cruising speeds of up to 290 m.p.h. The range is better than 800 miles and passenger capacity is 18-22. Take-off run to 50ft is only 850 yd, and an initial rate of climb of over 1,700ft/min is attained.

Armstrong Whitworth Apollo (four Armstrong Siddeley Mamba turboprops).

Great Britain's—and the world's—first pure-jet airliner to be seriously intended for commercial service was the de Havilland Comet, the first example of which flew on July 27th, 1949. Exemplifying the encouraging results obtained with this very remarkable aircraft is the fact that by August 25th it had flown 32 hours, and in the first 90 days, 95 hours. By June 15th, 1950, it had 324 hours to its credit—an average of one hour per day for the first 11 months. The second Comet flew on July 27th, 1950, and by January 8th this year the two machines had raised the flying time to over 525 hours. The third Comet took the air on January 9th this year, and differs from the earlier machines in having, as a standard fitment, the four-wheel bogie undercarriage in place of the single-wheel type. It is hoped that during 1951 sufficient Comets will have been delivered to permit B.O.A.C. to introduce the type into regular service by the end of the year, or early in 1952. One example has already been handed over to B.O.A.C. to explore crucial operating problems in different parts of the world.

The Comet in the form in which it is now flying, has the following characteristics: span, 115ft; length, 93ft; all-up weight, 105,000 lb; cruising speed, 490 m.p.h.; ultimate still-air range, with full tankage and 12,000 lb payload, 3,540 miles; stage length (full tankage, with 12,000 lb payload and full allowances, including 50-m.p.h. headwind and 200-mile diversion reserves), 2,140 miles; power plant, four D.H. Ghosts, each developing 5,000 lb static thrust; accommodation for 36 or 48 passengers in paired seats, plus two pilots, flight engineer, radio operator/navigator, and one or two stewards.

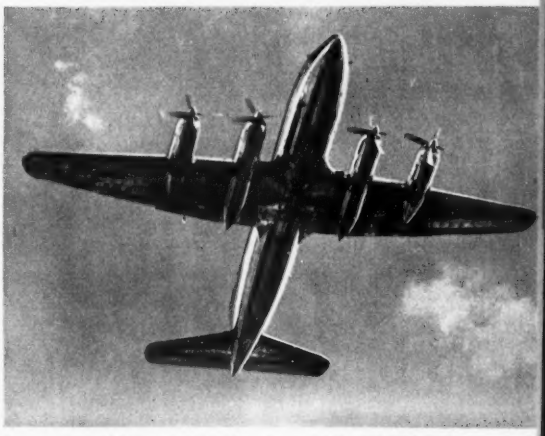
Such remarkable progress has been made with the Ghost-Comet that a development is already envisaged. The

Britain's Turbine Aircraft . . .

manufacturers have announced no details, but such a machine might be powered with four axial-flow turbojets of about 8,000-lb thrust and having a specific fuel consumption in the region of 0.75 lb/hr/lb thrust. It might have increased internal tankage; a lengthened fuselage accommodating about 50 passengers; and an increased all-up weight—perhaps 120,000 lb. Such a machine should be capable of carrying nearly its present capacity payload of 12,000 lb for a practical range of over 3,000 miles. Before its advent, however, the Ghost-Comet should benefit appreciably from higher thrust ratings.

The significance of the fact that, other than the Comet, the Avro Canada Jetliner is the sole pure-jet transport is that the development of pure-jet aircraft of this class has been confined to the British Commonwealth, and could not possibly be extended to America or other countries for a lengthy and crucial period. The Jetliner is powered with four Rolls-Royce Derwent Vs and weighs 60,000 lb. It must be emphasized that this machine is a seriously intended commercial proposition and—not withstanding a certain superficial resemblance to the Avro Ashton—is not confined to research and development-flying. The Ashton is a jet conversion of a piston-engined airliner and, like certain other British jet aircraft of its class, is duly referred to under the heading "Research Aircraft."

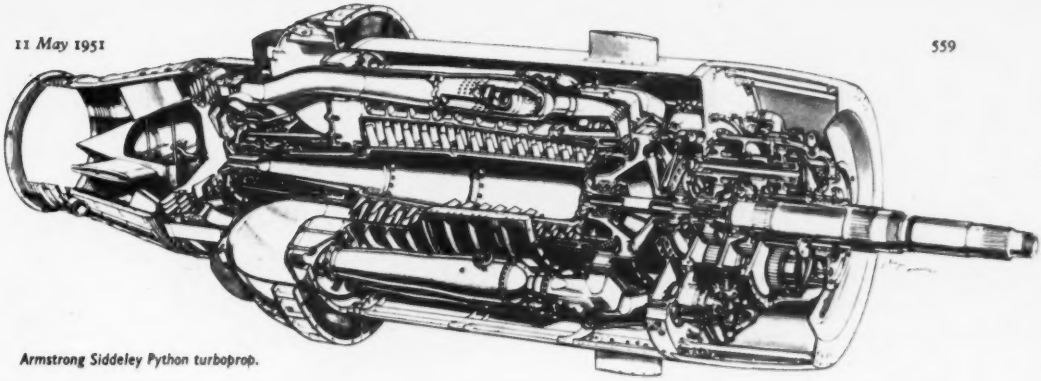
Turbine-powered commercial machines now building in Great Britain are the Bristol Brabazon II, with four Bristol Coupled Proteus, the Saunders-Roe Princess flying-boat (four Coupled Proteus and two single Proteus), and the Bristol Type 175 (four single Proteus). Saunders-Roe have a project for a high-speed flying-boat called the Duchess, with four Ghost turbojets.



Smooth, quiet and fast—the Handley Page Hermes V (four Bristol Theseus).

The Handley Page (Reading) Mamba-Marathon, below, is a fast feederliner.

A striking manifestation of Britain's lead in the development of turbine-powered commercial aircraft—the first three de Havilland Comets.



Armstrong Siddeley Python turboprop.

DESIGNS OF A DECADE

A Review of Turbojet and Turboprop Power Units: Some of the Problems Involved

By THE TECHNICAL EDITOR

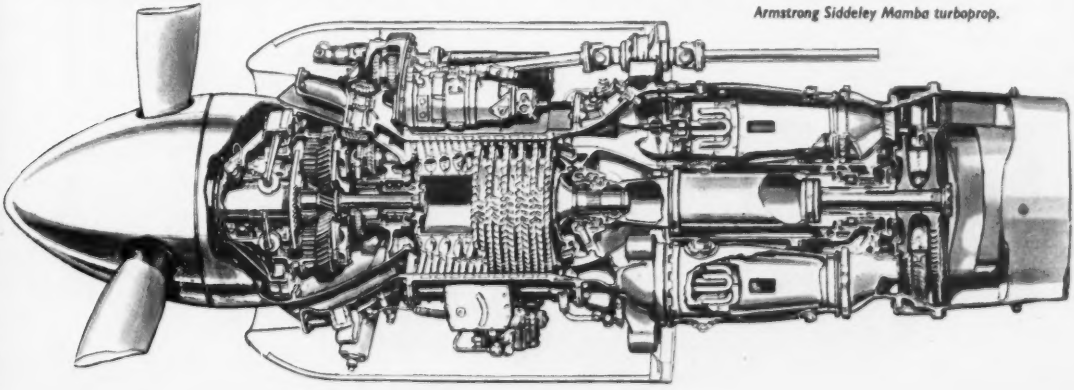
THAT history repeats itself is an undoubted truth and, to some extent, such a repetition is discernible in the genesis of internal combustion power units, albeit the circumstances are very different. Frank Whittle devised the first practicable form of gas turbine at a time when its rather distant second cousin, the steam turbine, had already been firmly established for a great many years. Likewise, Gottlieb Daimler devised the classic high-speed petrol engine some 60 years ago, although its predecessor and progenitor, the gas engine, had at that time been well established for a great many years.

Thus far the parallel. A sharp divergence is, however, to be found in the respective rates of development. In Daimler's time the fundamental theories of mechanical dynamics were well understood, but the infancy of metallurgy, and those branches of chemical and mathematical physics concerned with lubrication and vibration (to cite only two instances) were such that development of the h.-s. petrol engine was relatively slow during the first decades of its existence. By contrast, the immense strides made in all branches of mechanical, physical and chemical technology during the past 40 years, and particularly during the past 15 years, allied to the forcing-house conditions imposed by war—all these made possible in relatively so short a time the development of Whittle's first gas turbine into the comparatively advanced turbine power units which we know today.

The early years of Whittle's struggle are dealt with elsewhere in this issue, and we can, therefore, start our present review with mention of the first "production" turbojet to be manufactured in this country, the Rolls-Royce Welland. This power unit—which was the first of the Rolls-Royce "River" class of gas turbines—was a development of the Whittle/Power Jets W2B, and was ultimately used to power the Gloster Meteor 1. The unit had a double-sided centrifugal compressor delivering through a reverse-flow combustion system and, with a diameter of but 43in, could develop 1,700 lb thrust.

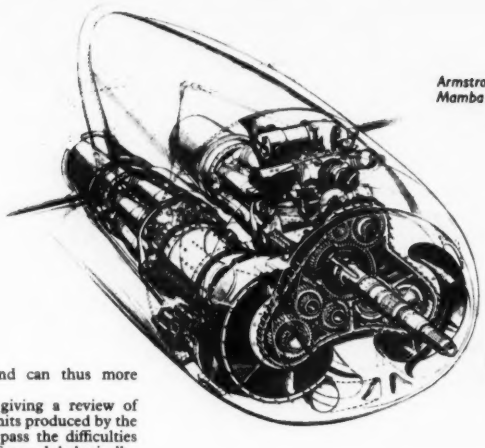
Gas-turbine power units are basically of two types, the turbojet and the turboprop, both names being self-explanatory. In these categories, however, the types are again divided into two main groups, those with centrifugal- and those with axial-flow compressors. Further variants exist in units which employ (*a*) both axial and centrifugal compressors; (*b*) either reverse-flow or straight-through combustion systems; and (*c*) common or "free" turbines. There are, of course, myriad diversities in detail component design, quite aside from such sub-type variations as afterburning (or re-heat), ducted fans, heat exchangers and so forth. Mention should also be made of the "compound" unit, in which a piston engine is employed as a high-pressure gas producer for a turbine.

Each of the classic forms of compressor has its advocates, and it is not possible to state in unequivocal terms that the centrifugal is a better proposition than the axial, or *vice versa:* each has intrinsic advantages which suit it for specific applications. In general, however, one can sum up the situation by stating that the centrifugal compressor is a simple component, which is cheap to produce, is extremely robust, can be run at high speeds and is not easily damaged by deleterious matter such, for example, as sand, grit, or ice. Together with these attributes, the centrifugal

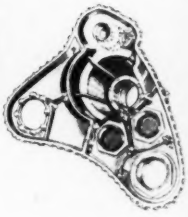


Armstrong Siddeley Mamba turboprop.

DESIGNS OF A DECADE...



Armstrong Siddeley Double Mamba for coaxial airscrews.



unit has a relatively wide effective operational range, which renders it particularly useful in a variable-speed, variable-load power unit. The axial compressor has the prime advantage that it is capable of producing a high compression ratio which, in turn, makes possible a reduction in fuel consumption; with this, it has a small frontal area. In addition, it possesses the inherent advantage that it is amenable to stage-by-stage modification, and can thus more conveniently be brought to its optimum.

Perhaps the most convenient method of giving a review of British gas turbines is to deal with the several units produced by the engine manufacturing companies, and to by-pass the difficulties of chronological inter-relation by listing the firms alphabetically.

Armstrong Siddeley Motors, Ltd., have consistently placed their faith in the axial-flow type unit, and were one of the earliest engine manufacturers to engage in the gas-turbine field. In 1939-40, the company manufactured and tested an experimental axial-flow compressor which had been designed at the R.A.E. on the basis of the theory first enunciated by Dr. A. A. Griffith in 1926. Two years later, the company was given a contract for an axial-flow turbojet of 2,500 lb static thrust at sea level, and with a specific consumption of less than unity. This unit, known as the A.S.X., employed a 14-stage axial compressor, and a two-stage turbine, and although the static thrust was, in fact, 2,600 lb, the specific consumption was 1.03 and thus did not quite reach the target figure.

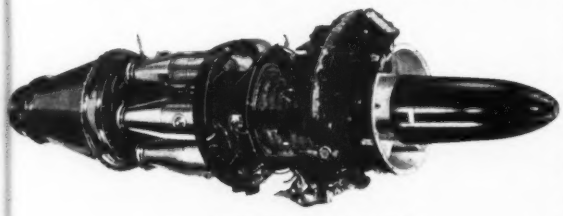
Whilst the A.S.X. was being developed, consideration was given to an alternative design in the form of a turboprop variant of the unit. The result was the Python which, delivering 3,670 s.h.p., differs from the A.S.X. chiefly in having a reduction gear for the contra-rotating airscrew and a turbine re-designed in order to provide power to drive the airscrew in addition to the compressor. The small diameter and relatively lengthy compressor make it convenient to group the 11 combustion chambers around the compressor casing, and it is clearly apparent from the drawing of the unit (p. 559) that a reverse-flow compressor/combustion system is employed.

The air inlet casing is a semi-torus divided radially into 11 convergent throats, through which the entrained air is swept inward through 180 deg to the entry annulus of the compressor. Each of the first five (low-pressure) stages has 36 blades, whilst the remaining nine (high-pressure) stages employ 70 blades each. From the compressor, the air is delivered into an annular angle-section trunk, with a concentric tier of guide vanes at the elbow, thence being divided into 11 separate combustion chamber inlet ducts, again with rectifying vanes across the angle, so that the air is once more turned through 180 deg.

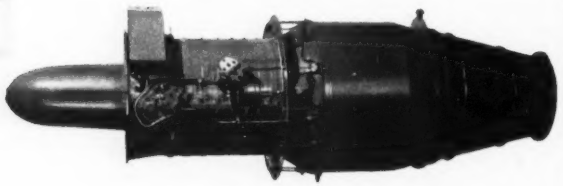
Each combustion chamber encloses a fabricated flame-tube embodying a vaporizing volute, and the burnt gases, together with the diluent air, are carried from each chamber down relatively long, slightly tapering extension trunks, which terminate at a transfer ring, the 11 ports through which are circumferentially divergent so as to direct the gases into the turbine nozzle ring in an annular stream. After expanding through the two-stage turbine, the gases are exhausted to atmosphere in the usual way.

In 1945, Armstrong Siddeleys started work on the design of a smaller turboprop, which was given the name Mamba. The unit was first run in April 1946 and, although utilizing an axial compressor, differs fundamentally from the larger Python, in its employment of a straight-through flow system. The inlet takes the form of an annular entry duct surrounding the epicyclic reduction gear, and leads direct into the ten-stage compressor, the compression ratio of which is 5:1. From the compressor, the air is delivered to six combustion chambers, designed to provide the optimum heat liberation from the fuel mixture. Like the Python, a two-stage turbine is featured in the Mamba, but whereas the Python turbine takes the form of a single disc carrying two rows of rotor blades, in the Mamba a pair of discs, each carrying a row of blades, is used, the discs being connected through a Hirth coupling and carried on a common transmission shaft.

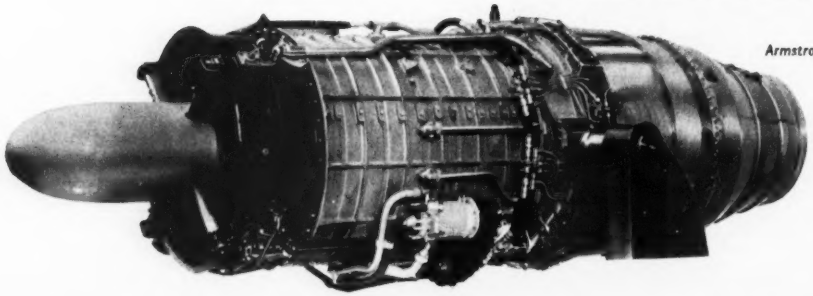
In the early part of 1949, Armstrong Siddeleys introduced the Double Mamba, a power unit comprising two Mambas linked through a common reduction gear to drive co-axial airscrews. Each unit of the twin delivers 1,270 s.h.p. with a residual jet thrust of 384 lb at a mass flow of 17 lb/sec. Two further variants of the Mamba have been more recently developed; the first, a plain



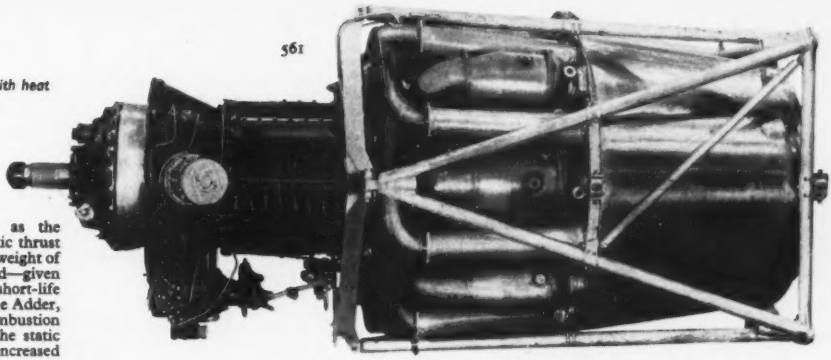
Armstrong Siddeley Adder turbojet.



Armstrong Siddeley Viper short-life turbojet.



Armstrong Siddeley Sapphire turbojet.



Bristol Theseus turboprop with heat exchanger.

turbojet version known as the Adder, gives 1,050 lb static thrust at sea level, and has a dry weight of 580 lb, whilst the second—given the name Viper—is a short-life experimental version of the Adder, but with an annular combustion chamber, and in which the static thrust output has been increased to 1,500 lb.

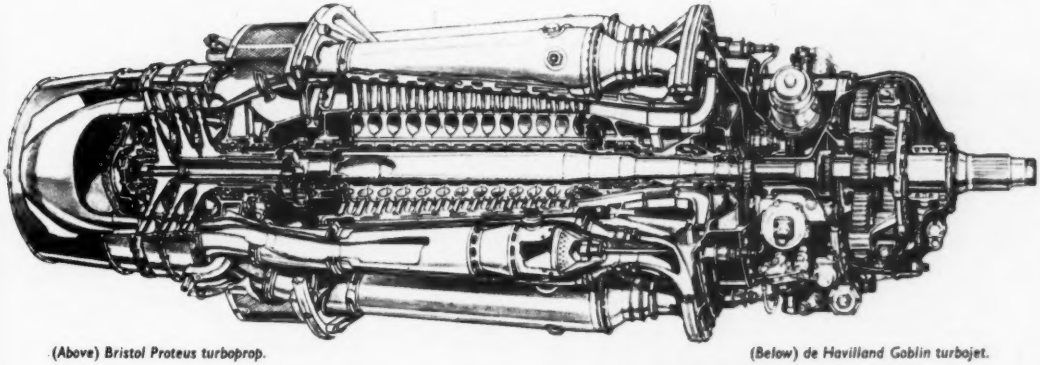
The latest, largest and, so far as internal details are concerned, still-secret Armstrong Siddeley turbojet is the Sapphire. Developed from an original design by Metropolitan-Vickers, Ltd., the Sapphire has an axial-flow compressor and an annular combustion chamber, and completed the 150-hour Service type test at a sea level static thrust rating of 7,220 lb, with a specific consumption of 0.916 lb/hr/lb. These figures make the Sapphire the most powerful turbojet engine in the world yet to have flown, and the low specific fuel consumption speaks volumes for the efficiency of the design as a whole.

The Bristol Aeroplane Co., Ltd., first released details of their Theseus turboprop towards the end of 1945. This unit aroused considerable interest, for it bristled with unusual features. A nine-stage axial compressor delivered into a final centrifugal stage, giving an overall compression ratio of 5:1. Flow from the compressor was delivered to a matrix-type heat-exchanger before passing to the combustion chambers, and a three-stage duplex turbine was used, the two-stage first turbine powering the compressor and auxiliaries, whilst the single-stage second turbine—of so-called "free" type—drove the airscrew through an epicyclic reduction gear. A free-turbine obviates airscrew starting drag.

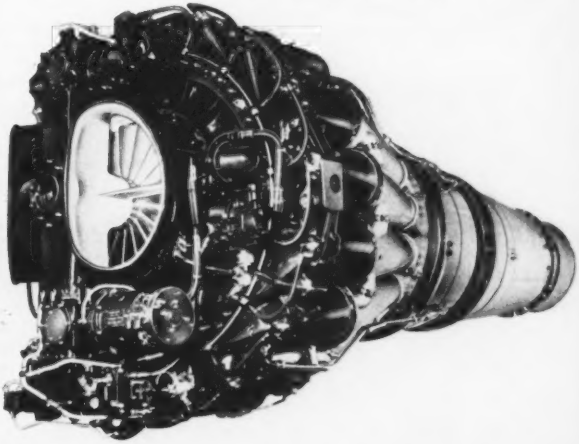
Experience gained with the Theseus was put to good use in the development of the Proteus. In fundamental layout, the units differ appreciably, the Proteus having a reverse-flow compressor/combustion system, although as before, an axial compressor delivering through a final centrifugal stage is utilized. Again, a three-stage duplex turbine is used, but, in the Proteus, the first two turbine stages (which drive the compressor) are individual wheels splined to a common shaft instead of following Theseus practice in employing two rows of blades on a common disc. The third stage (airscrew-driving) turbine is a "free" unit. A preliminary turbojet version of the Proteus was developed by the company, and served as a research unit. Given the name Phœbus, it produced 2,540 lb static thrust at 10,000 r.p.m. In coupled form, the Proteus will power the second prototype Brabazon, and the Saunders-Roe Princess. In this connection, it should be emphasized that the power installation differs fundamentally from that of, for example, the Double Mamba in that, whereas each unit of the Double Mamba drives its own airscrew, both units of the coupled Proteus commonly drive a contra-rotating airscrew. The basic difference shows up in the fact that, if one of the twin units fails, in the case of the "double" (Mamba) installation, the appropriate airscrew is stopped and feathered, whereas in the "coupled" (Proteus) instance, the remaining live engine takes over the duty of both and drives the airscrew by itself. In short, the doubled installation employs two airscrews mounted one behind the other and rotating in opposite directions, whereas the coupled installation drives a single airscrew made up of two banks of contra-rotating blades.

Two new turbojets are now engaging the attention of the Bristol Engine Division, one of them being the Olympus, a high-powered unit which embodies twin axial-flow compressors, and which is designed to operate at a very low fuel consumption. Beyond this, however, nothing else may be mentioned of the projects.

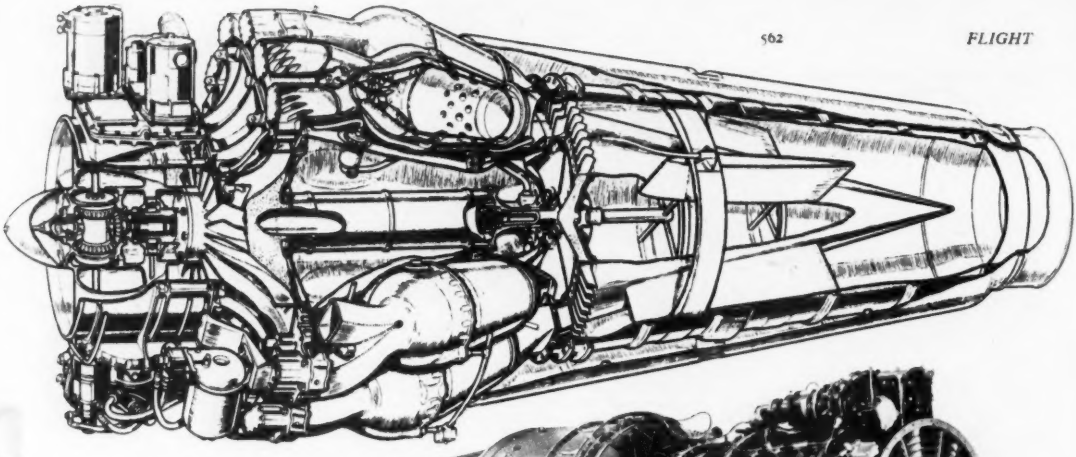
The de Havilland Engine Co., Ltd., early in 1941, began considering the design of a turbojet for use with the Vampire fighter. Sixteen months later, the unit, which was given the name Goblin, was ready for testing, and by June, 1942, had been operated at its full designed thrust of 3,000 lb. Just as Armstrong Siddeleys have consistently advocated the axial-flow design, so de Havillands have equally consistently held to the centrifugal



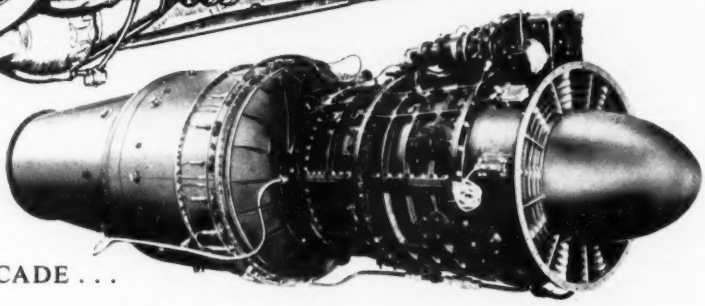
(Above) *Bristol Proteus turboprop.*



(Below) *de Havilland Goblin turbojet.*



(Above) de Havilland Ghost turbojet.



(Right) Metrovick Beryl turbojet.

DESIGNS OF A DECADE . . .

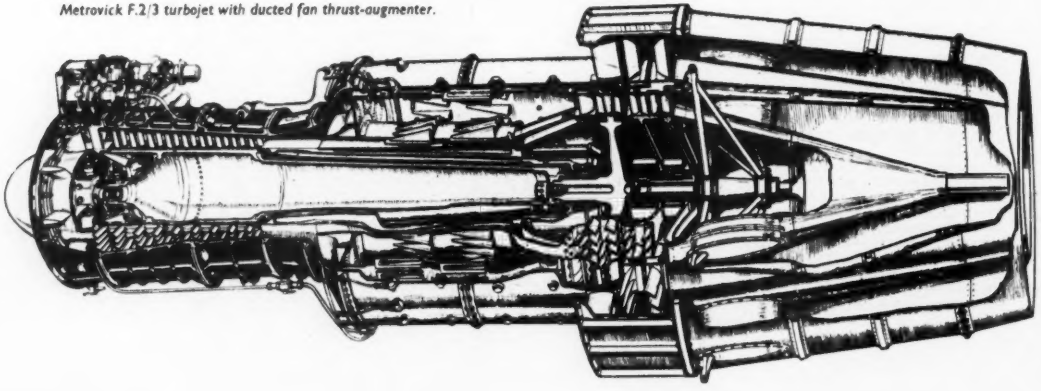
compressor; not only in general terms, but more specifically, in advocating the single-sided centrifugal type. The Goblin can to some extent be regarded as a linear descendent of the early Whittle concept of the turbojet, and is delightfully simple in basic layout. Elliptical-nostril intakes give direct into the eye of the single-sided centrifugal compressor, the delivery from which is distributed between 16 combustion chambers. These feed the single-stage turbine which drives the compressor through a tubular shaft, the compressor and turbine forming a single rotating assembly mounted on only two bearings. It must be recorded that the Goblin passed an official type approval test in January, 1945, and, as a result, holds Type Certificate No. 1 for a turbine unit for aircraft propulsion.

Following on from the Goblin, and resembling it in fundamental layout, the Ghost was the next unit produced by the company. It was first run in October, 1945, and early the following year was developing its rated output of 5,000 lb thrust. In order to keep down the diameter as much as possible, cascade vanes are fitted in the compressor-diffuser to turn the air axially as it leaves the diffuser vanes. Each of the ten combustion chambers which, understandably, are of considerably greater volume than those of the Goblin, receives air from the compressor-diffuser through twin branch pipes. It says much for the design of the combustion system that a compression ratio of 4.26:1 is achieved and that the specific fuel consumption of the unit is 1.06 lb/hr/lb.

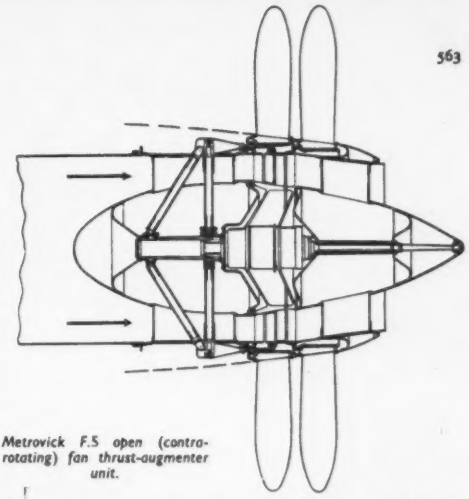
Metropolitan-Vickers, Ltd., were perhaps the first commercial company to engage in the gas-turbine field, for in 1938 they collaborated with the R.A.E. in designing a power unit, known as the B. 10, which embodied a nine-stage axial compressor driven by a four-stage turbine. The company have, of course, an immense background of experience in the design and manufacture of steam turbines, and in view of this it is only natural that, in connection with gas-turbine design, their attention should have been focused on the axial-flow type of unit. In 1940 they started the development of a unit which, designated F.2, embodied a nine-stage axial compressor, an annular combustion chamber and a two-stage turbine. The power unit passed a 25-hour special category test in November, 1942, with a thrust rating of 1,800 lb, and a year later a pair of these units, installed in a modified Gloster F 9/40 (the forerunner of the Meteor) made possible the first flight of a British aircraft propelled by axial-flow turbojets. The F.2/4 was developed into the Metrovick Beryl, modifications including a ten-stage axial-flow compressor and a single-stage turbine. For a weight of 1,750 lb, the Beryl gave a take-off thrust of 3,500 lb, at which the specific fuel consumption was 1.05 lb/hr/lb. This last figure, however, was reduced to 1.00 lb/hr/lb at the cruise rating of 3,000 lb static thrust at sea level.

Interesting developments undertaken by the company in the thrust-augmentation field were seen in the F.3 and F.5 power units. The F.3 was basically an F.2 turbojet, modified to incorporate a four-stage turbine immediately downstream of the normal two-stage (compressor-driving) turbine, the new four-stage unit

Metrovick F.2/3 turbojet with ducted fan thrust-augmenter.

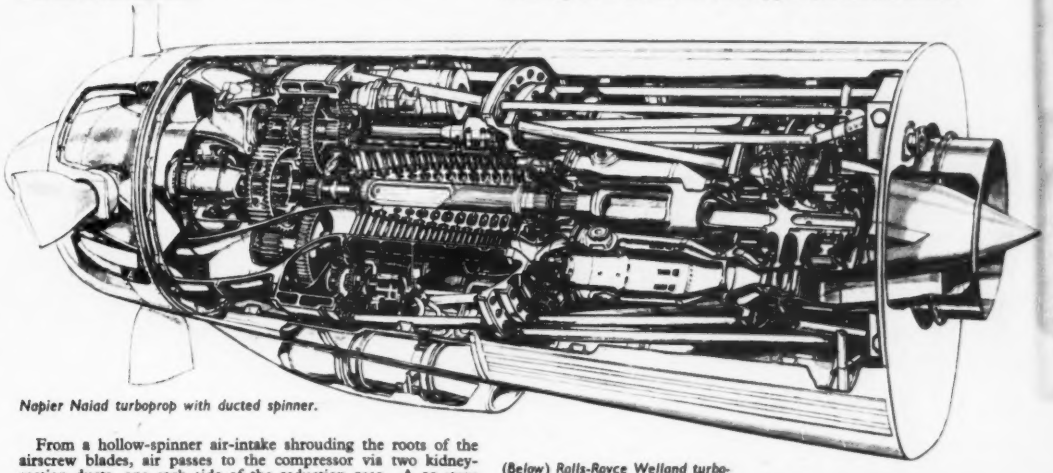


taking the form of two contra-rotating wheels, with tip-shrouded blades, the shrouds serving as mounting rings for two rows of augmenter fan blades. These contra-rotating fans operated in an annular duct, and augmented the total thrust by no less than 67 per cent. The F.5 power unit comprised basically an F.2/4 turbojet, serving as a gas generator for a contra-rotating fan of open, as opposed to ducted, type. Gases passed from the generator through a straight duct to the augmenter turbine, a four-stage contra-rotating unit essentially similar to that used in the F.3, but remotely mounted at the tail extremity of the duct in its own nacelle fairing, and carrying on the tip shrouds two rows of fan blades. These fans were essentially multi-bladed airscrews of 5ft 6in diameter, the leading unit having 14 blades and its downstream complement 12 blades, all of fixed pitch. By comparison with the turboprop power unit, as it exists today, the open-fan augmenter has the advantage of lightness, simplicity and absence of gearing, and by comparison with the F.3 ducted-fan unit, the F.5 gave a 100-lb increase in thrust whilst being 100 lb lighter in weight. Metrovick ceased development of these units, however, in favour of concentrating work on the Sapphire (subsequently taken over by Armstrong Siddeleys) and the company later decided to withdraw from the aircraft gas-turbine field. It is, however, entirely possible that the last has not been seen of the open-fan type augmented power unit for aircraft, in that there are many indications that such units will conveniently bridge the transition stage from the operational zone of the turboprop to that of the turbojet.



Metrovick F.5 open (contra-rotating) fan thrust-augmenter unit.

D. Napier and Son, Ltd., did not release full details of the Naiad turboprop until 1948, but when these details were published they aroused considerable interest by reason of the unique structural form employed. From the main mounting ring (lying in the plane of the final compressor stage) subsidiary supporting structures project forward to carry the front half of the engine by picking up to the reduction gear casing, and run rearward to support the rear half by attachment to the turbine inlet manifold. By this means, the compressor casing and the turbine shaft housing are relieved of bending loads.



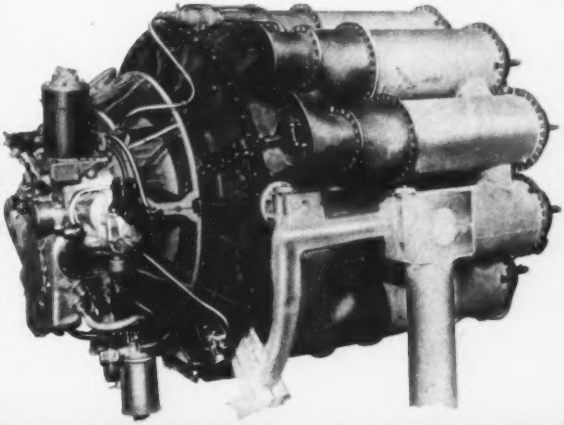
Napier Naiad turboprop with ducted spinner.

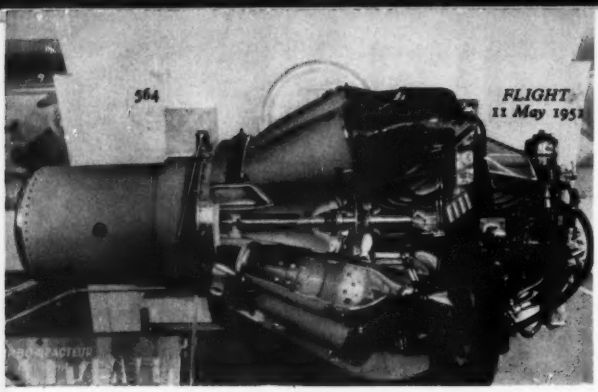
From a hollow-spinner air-intake shrouding the roots of the airscrew blades, air passes to the compressor via two kidney-section ducts, one each side of the reduction gear. A 12-stage axial compressor gives a compression ratio of 5.5 : 1, and the mass airflow at peak r.p.m. is 17.2 lb/sec, an exceptional figure for a unit of but 10.82in in diameter. Delivery from the compressor is given to five combustion chambers of conventional design, which feed the two-stage turbine. As a result of the unusual structural form of the Naiad, it is necessary for the rotating assembly to be articulated. To this end, the compressor is carried in a gimbal assembly at its rear end, and in a self-aligning bearing at its forward end, torque connection being made through annular couplings.

Reference is now permissible to the latest Napier power unit, the Nomad NNm. 3, but no details are available beyond bare mention that the unit is of compound type; that is to say, of a kind in which a piston engine serves as a high-pressure gas generator for a turbine. The great attractiveness of such a design is that an exceptionally low specific fuel consumption can be attained.

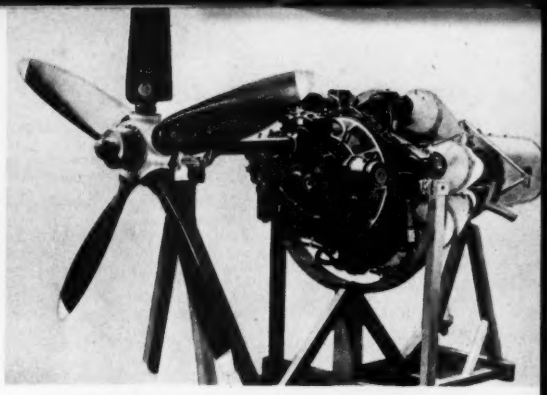
Rolls-Royce, Ltd., established a department for the design of gas turbines in 1938, and subsequently the company manufactured components for Whittle units, thereafter undertaking the construction of a Whittle-type turbojet known as the WR1. Then, in 1943, research on the W2B/23 unit was taken over from the Rover Company, who had developed a straight-through combustion system. As already mentioned, the W2B was the forerunner of the first Rolls-Royce turbojet, the Welland. Experience gained with this development work was applied to a new project, designed to replace the Welland in the standard Meteor nacelles, but with a static thrust rating of 2,000 lb. The new unit was known as the Derwent 1, and it was further developed in a number of series. The Derwent 2 gave an increased thrust of 2,200 lb, the Series 3 was a special unit for experiments with wing boundary-layer control by suction, whilst the Series 4 gave an additional increase

(Below) Rolls-Royce Welland turbojet. A derivative of a Whittle design.





Rolls-Royce Derwent turbojet.



Rolls-Royce Trent turboprop; the first in the world to fly.

DESIGNS OF A DECADE . . .

in thrust of 2,400 lb. Then came the Derwent 5 which, whilst retaining the maximum diameter of 43in, was an entirely new unit —although of essentially similar basic design—developing twice the thrust of the original Derwent 1 for an installed weight of but 1,500 lb.

As in the original Whittle turbojets, the Derwents employ a double-sided centrifugal compressor to feed nine combustion chambers, which discharge to a single-stage turbine, the main shaft being mounted in two roller bearings and a central ball thrust bearing. The Derwent 5 is, in fact, a scaled-down version of a larger unit, the Nene, which, with a diameter of 49½in, develops a thrust of 5,000 lb for a weight of only 1,550 lb. It is not without interest that the first aircraft to be powered by a Nene was a Lockheed XP-80 Shooting Star.

Although frequently regarded as a somewhat conservative concern, Rolls-Royce are, in fact, not in the least inhibited in outlook, and are usually in the forefront of advanced thinking. In 1945, the company tested the first turboprop in the world to fly. Known as the Trent, the unit was virtually a Derwent equipped with a reduction gear to drive a small-diameter, five-bladed Rotol airscrew, and it was developed purely in order to gain experience with a power unit combining jet and airscrew propulsion. One of the major difficulties associated with the turboprop is in relating the individual performances of the airscrew and the power unit; and it was on the Trent that this control problem first came to light.

Following on from the Trent, Rolls-Royce set about the development of a small turboprop, which was given the name Dart. This singularly robust and attractive little unit is unique in that it makes use of a two-stage centrifugal compressor system, comprising two single-sided impellers. The efficiency of this system is indicated by its delivery of a mass-flow of 18 lb/sec at a compression ratio of 5.5 : 1. From the diffuser of the final compressor stage, the air passes to seven straight-flow combustion chambers, helically disposed for discharge to a two-stage turbine. The turbine output shaft engages the compressor shaft through a spherically seated coupling, and drive is continued from the compressor assembly by means of a quill-shaft to the input member of the compound plain and epicyclic reduction gear.

Although Rolls-Royce have such an unrivalled background of experience with centrifugal compressors, this has not blinded them to the evident virtues of the axial-flow type, and the company did, in fact, manufacture a large turboprop unit of 3,000 s.h.p., known as the Clyde. This unit enunciated yet another variation in drive distribution, in that it embodied a nine-stage axial compressor discharging to a single centrifugal final stage, which fed the nine combustion chambers. The drive distinction was vested in the use of two turbines, the foremost (high-pressure) unit driving the centrifugal compressor, whilst the rearward (low-pressure) turbine drove the axial compressor and the reduction gear for the contra-rotating airscrew.

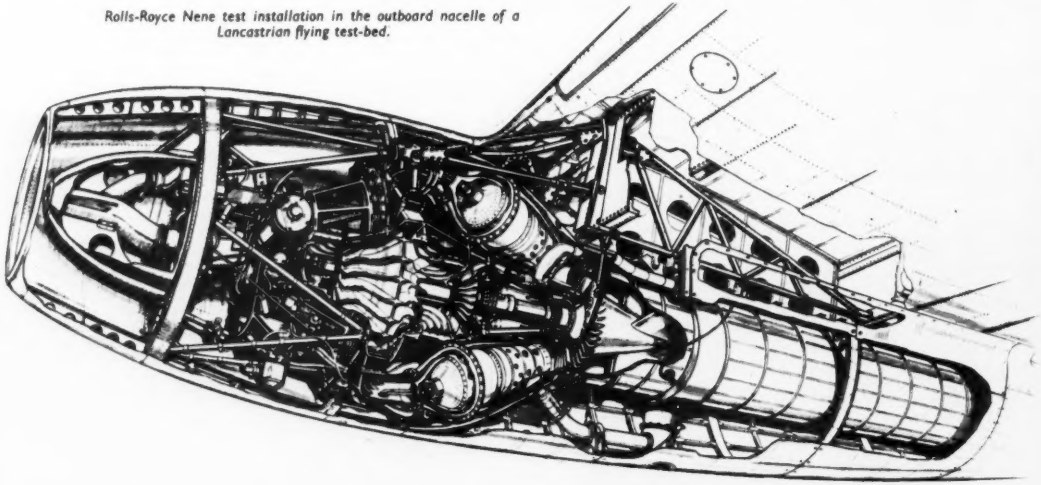
There is little doubt that the preliminary axial-flow experience gained with the Clyde proved of use in the design of the latest and largest Rolls-Royce turbojet, the Avon. Internal details of this unit are still secret, but it has been admitted that a thrust of 6,500 lb is delivered—and there can be little doubt that this thrust figure errs well on the conservative side. Delivery from the axial compressor is given to eight combustion chambers which, as is only to be expected, are of large volume. Designated as the power unit of the Canberra jet bomber, and almost certainly to be used by other, still-secret, aircraft, the Avon is to go into production on a scale matched, perhaps, by only one other engine, the Rolls-Royce Merlin.

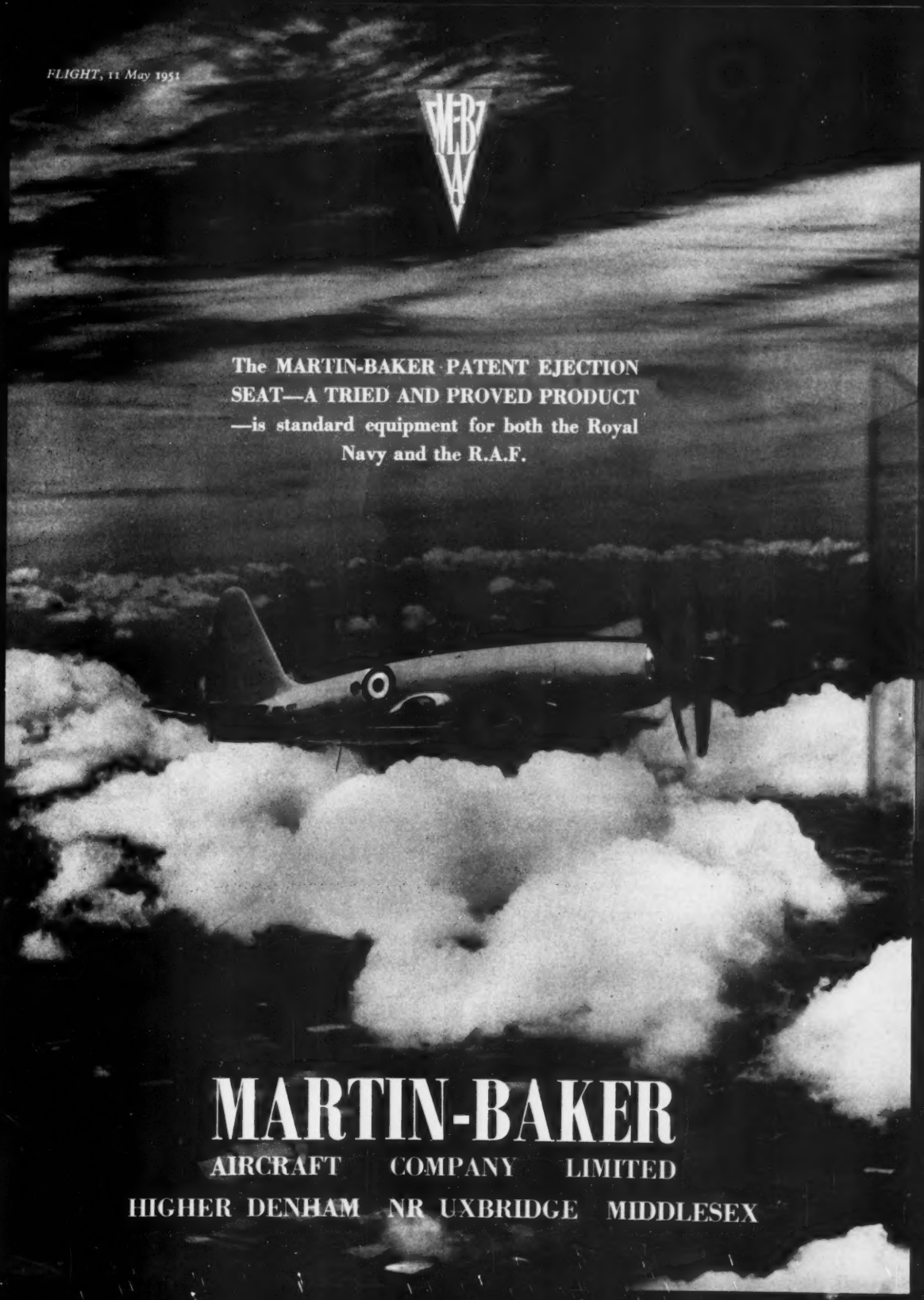
To conclude this brief review of British aircraft gas turbines, mention must be made of the Rolls-Royce Tay. Again, full details of the unit are restricted, although it can be stated that it is, in fact, an enlarged version of the Nene, in which widespread use is made of magnesium alloy. The thrust delivered is 6,250 lb, and the specific consumption is the remarkably low figure of 0.87 lb/hr/lb.

Although in the early phases of gas-turbine development the facile simplicity of the new form of power unit was extremely attractive, it soon became apparent that considerable problems were involved and, moreover, were rendered none the more soluble by being, in general, of a kind about which few data existed. Pioneer work was called for in most fields, and today the research effort still continues undiminished.

Most of the early units suffered from low turbine-efficiency

Rolls-Royce Nene test installation in the outboard nacelle of a Lancastrian flying test-bed.





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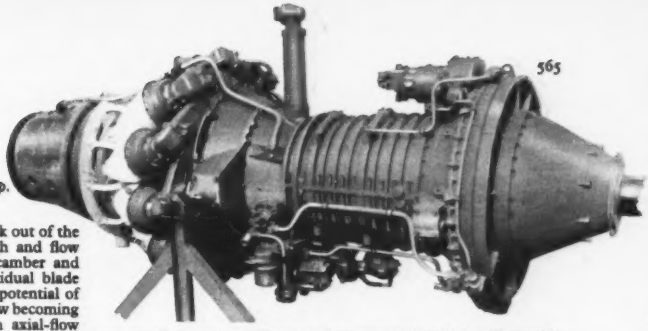
DESIGNS OF A DECADE . . .



Rolls-Royce Clyde turboprop.

simply because of the effort made to get too much work out of the blades. The blade lift-coefficients were far too high and flow break-away resulted. By reducing the amount of camber and increasing the number of stages, however, the individual blade loading is reduced without detracting from the work potential of the turbine, and that is why multi-stage turbines are now becoming more common. Compressor design—particularly in axial-flow types—has also advanced enormously of late years. The first axials had a compression ratio of little more than 2 : 1, and an efficiency of something below 80 per cent, whereas today it is possible to attain compression ratios of about 7 : 1 in conjunction with percentage efficiencies of the order of 85. That there is a certain limit to the compression ratio attainable with a single compressor is obvious, but the demand for ever higher ratios will continue, for fuel consumption, thrust, weight and bulk all hinge on compressor performance. It is, therefore, entirely possible that before long we shall have power units embodying multi-compressor systems in which each compressor is driven by its own turbine.

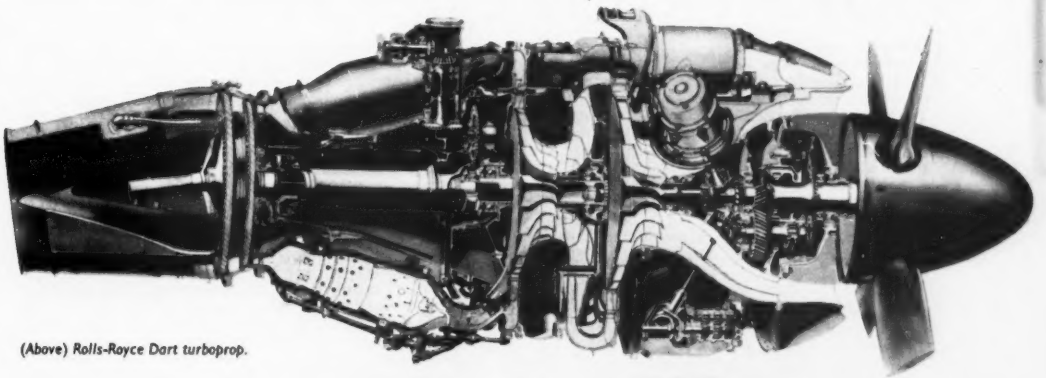
An enormous amount of work has been done on combustion research, not the least problem in this field having been the attainment of flame stability under all operating conditions. Burner design, the design of spray nozzles, vaporizing systems, and cooling-flow systems, all have received—and are still receiving—a vast amount of attention. The annular combustion chamber is a development which offers much; certainly it has its problems, but these have largely been solved, and the fact that it permits the maximum use to be made of the cross-sectional area available, and permits a chamber of given capacity to have a reduced frontal area, would seem to assure its future use. First featured on the Beryl, annular combustion chambers are now to be seen on the Sapphire and the Viper.

The metallurgical problems associated with gas-turbine development have been tremendous. In particular, it is the turbine blading which has been the greatest single cause of difficulty, for the conditions under which a gas-turbine blade has to operate are something of a metallurgical nightmare. In conjunction with a bright red-heat temperature of anything up to 800 deg C, the blade has to withstand a centrifugal load of, perhaps, ten tons per square inch and, with this, a bending load of as much as five to six tons per square inch. And this is not all; considerable fluctuating bending stresses can also exist and so aggravate the vibrational aspect of the matter. Research into materials which will provide the requisite physical properties for the arduous conditions imposed by the gas turbine is as important today as ever. Great strides have been made during the past ten years, and we now use metals with characteristics which were undreamed of only a few years ago. Here again, progress will go on, for the higher the temperature at which the turbine can work, the greater the thrust developed. But metallurgical interest in the gas turbine is not centred exclusively on the turbine itself; the compressor also possesses considerable problems—particularly the axial-flow units.

In the largest turbojets, the number of blades in the compressor may total anything between 1,500 and 2,500. These blades do not have to withstand the elevated temperatures imposed on turbine blades, but the centrifugal and bending loads are not much less, and the accuracy of each individual blade is critical. This imposes manufacturing problems of some magnitude, and great interest is now being displayed in sintered blades—a development in which the metallurgist plays a leading part.

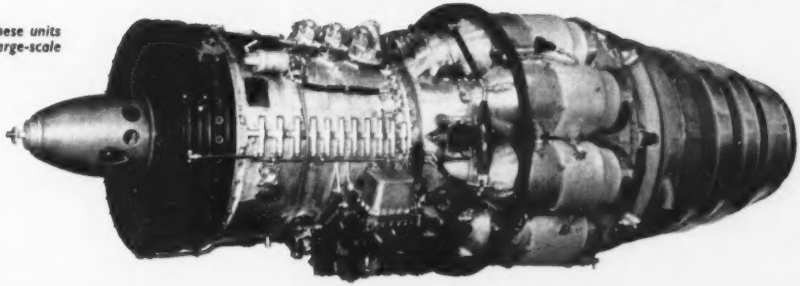
The menace of icing exerts its influence on the gas turbine as well as on the aircraft as a whole. When it is realized that a turbojet delivering 5,000 lb thrust consumes about 1,200 cu ft of air per second, it is readily appreciated that icing conditions involve a considerable potential hazard. The centrifugal compressor is generally recognized to be capable of swallowing large amounts of ice without hurt, but the mass of blades in an axial compressor need protection if they are to escape injury.

Perhaps naturally, the schemes for providing anti-icing protection have been many and various, but most of the great engine companies now seem to be working along the same lines. Thus although the individual approaches differ, all have in common the abstraction of air from the compressor at a (compression) stage just sufficient to provide the minimum pressure adequate for the purpose, the air then being fed to an auxiliary combustion chamber, where a temperature of, say, 700 deg C is produced. From this



(Above) *Rolls-Royce Dart turboprop.*

Rolls-Royce Avon turbojet. These units are now being put into large-scale production.



DESIGNS OF A DECADE . . .

small combustion chamber the hot gases are manifolded to the intake and are exhausted into the inlet stream, the temperature of which is so raised as to make ice formation impossible.

In conclusion, a few words must be said about short-term power increase methods. Of these, the most spectacular is afterburning, i.e., a method whereby the thrust is increased by as much as 40-50 per cent simply by burning extra fuel in the exhaust jet downstream of the turbine. The fact that the fuel consumption is so greatly increased by afterburning makes the method acceptable only for emergency and combat conditions, and although no extra stresses are imposed on the turbine, the major change in the jet-pipe flow conditions makes it necessary to employ a variable-area outlet orifice in order to take full advantage of the increased thrust afterburning makes available. Another method of deriving short-term thrust increase is by injecting water, water-methanol or alcohol into the compressor to increase the volumetric efficiency and so produce greater thrust. The increase obtainable is not so great as that given by afterburning, but on the other hand the fuel consumption of the power unit is not affected; nevertheless, the additive fluid has to be carried and so introduces a stowage problem, although not of great import. For restoring standard take-off power in tropical or high-altitude conditions, water-methanol injection has much to commend it, and the system is, in fact, to be used with the Rolls-Royce Dart in the Vickers Viscount.

DATA ON CURRENT GAS TURBINES

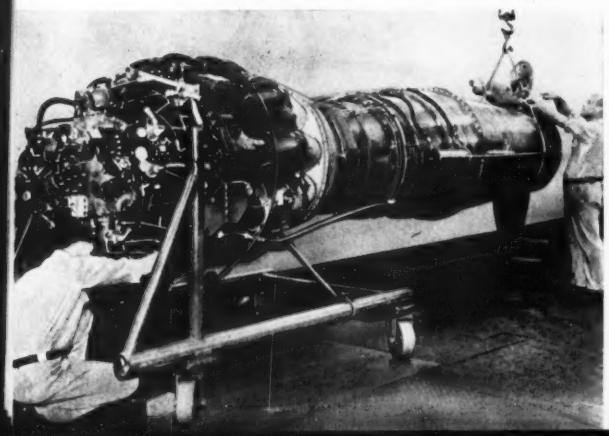
Maker's name and engine type	Type of compressor	No. of combustion chambers	Max. Power Rating (sea-level static)			Recommended Economical Cruising Power				Specific fuel Consumption lb/eshp/hr or lb/hr/lb	Diameter or Width (in)	Length (in)	Dry weight (lb)	Remarks
			Thrust (lb)	Shaft h.p.	r.p.m.	Thrust (lb)	Shaft h.p.	r.p.m.	Speed (m.p.h.) at height					
ARMSTRONG SIDDELEY:														
Python	A	11	1,150	3,670	8,000	250	2,250	7,600	350 at 20,000	0·60	54·5	122·77	3,150	Naval production order
Mamba	A	6	405	1,320	15,000	100	740	14,500	350 at 20,000	0·67	29	87·33	770	Cowled diam. 31 in.
Double Mamba	A	2 x 6	810	2,640	15,000	200	1,480	14,500	350 at 20,000	0·67	52·8	98·73	2,000	Double unit: height 43·85 in.
Adder	A	4	1,100	—	15,000	375	—	14,250	350 at 30,000	1·20	28	73·3	550	Turbojet version of Mamba
Sapphire	A	Ann.	7,200	—	—	—	—	—	—	0·907	32·25	133·85	2,500	Frontal area 6·8 sq ft.
BRISTOL:														
Proteus 2	A and C	8	800	3,200	10,000	380	1,025	9,500	350 at 35,000	0·51	38·5	113·4	3,050	
Coupled Proteus	A and C	2 x 8	1,600	6,400	10,000	760	2,050	9,500	350 at 35,000	0·51	84	140·4	7,180	Princess and Bristol 167
Theseus	A and C	8	825	2,220	8,200	145	1,170	7,800	300 at 20,000	0·773	54	82·6	2,205	
Olympus	—	—	—	—	—	—	—	—	—	—	—	—	—	No data released
DE HAVILLAND:														
Ghost 50	C	10	5,000	—	10,250	3,350	—	9,000	S.L. static	1·02	53	121	2,218	As for Comet
Goblin 3	C	16	3,350	—	10,750	2,220	—	9,500	S.L. static	1·18	49·85	100·5	1,629	
Goblin 35	C	16	3,500	—	10,750	2,320	—	9,500	S.L. static	1·16	49·85	100·5	1,629	
NAPIER:														
Nomad	—	—	—	—	—	—	—	—	—	—	—	—	—	"Compound" unit. No other data released.
ROLLS-ROYCE:														
Avon	A	8	6,500	—	—	—	—	—	—	—	—	—	—	Data secret. Rating quoted for early development unit
Nene	C	9	5,000	—	12,530	4,000	—	11,800	S.L. static	1·02	49·5	97	1,755	
Derwent 5 and 8	C	9	3,600	—	14,700	3,090	—	14,100	S.L. static	1·025	43	83	1,280	
Dart	2C	7	365	1,400	14,500	295	1,120	13,800	S.L. static	1·005	38·5	95	929	

JET PROGRESS ABROAD

AMERICA was the second nation to adopt the gas turbine on a large scale, though in saying this we exclude Germany, whose development of this type of power unit was abruptly terminated on V.E. Day. The first of America's numerous successful turbojets was the centrifugal-flow J-33, originally developed by General Electric from a Whittle design and subsequently mass-produced by Allison. This unit is used in the F-80 and T-33 Shooting Stars, F9F-3 Panther, AJ-1 and P4M-1 Mercator, and its thrust rating has been greatly increased to the current figure of 5,400 lb with water injection. The J-33 has been operated for a total flying time probably exceeding that of any other turbojet and is, consequently, an exceptionally reliable unit with the unusually long overhaul period of 300 hours.

Another widely used Allison unit is the axial-flow J-35 (4,200 lb "dry" static thrust), which powers several important military types, including the Thunderjet and Scorpion. The Allison T-38 turboprop, developed for the U.S. Navy, produces 2,750 h.p. and is installed in America's first turbine-engined transport—the Turboliner, a modified version of the Convair 240 twin-engined airliner. Two T-38s are coupled—to drive a six-blade co-axial airscrew through a mutual reduction gear—in the T-40, a 5,500 h.p. unit which powers the XA2D-1 Skyshark naval attack aircraft and the XP5Y-1 flying boat (four T-40s).

General Electric (which produced the original designs of the Allison J-33 and J-35) supply the U.S.A.F. with one of its most important power units—the J-47. This axial-flow unit, rated at 5,200 lb without water injection, is used in the Sabre, Stratojet and Tornado, and four J-47s in "pods" provide extra power for the B-36 bomber. A later and more powerful design is the J-53. Now coming into increasing prominence as a producer of jets for high-speed aircraft, the Pratt and Whitney division of the United Aircraft Corporation has so far concentrated mainly on turning out, under licence, versions of two Rolls-Royce turbojets—the Nene and Tay. The Tay (designated J-48 Turbo-Wasp by Pratt and Whitney) is claimed to be the most powerful turbojet in production in the U.S.A.: it gives a dry rating of



TAY WITH A TAIL: Pratt and Whitney's version of the Rolls-Royce Tay turbojet. Designated J-48 Turbo-Wasp, it is shown with afterburning equipment, which raises the take-off thrust to 8,900 lb.

The most difficult Air Route in the World

ACROSS THE ATLANTIC 1919

The Rolls-Royce "Eagle" powered Vickers Vimy made the first direct crossing of the Atlantic by air, in 16 hours 12 minutes.

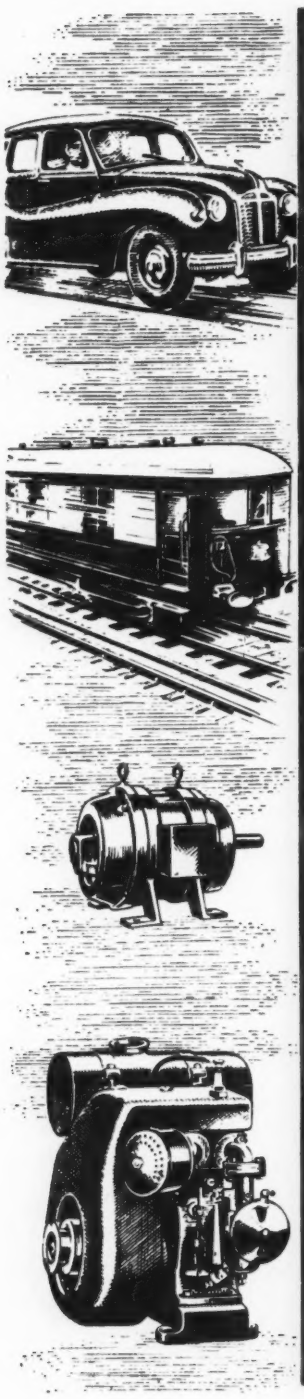
ACROSS THE ATLANTIC 1951

The Rolls-Royce "Avon" powered English Electric Canberra was the first jet aircraft to fly the Atlantic direct without refuelling, in 4 hours 37 minutes.

ROLLS-ROYCE *Aero*

ENGINES

FOR SPEED AND RELIABILITY



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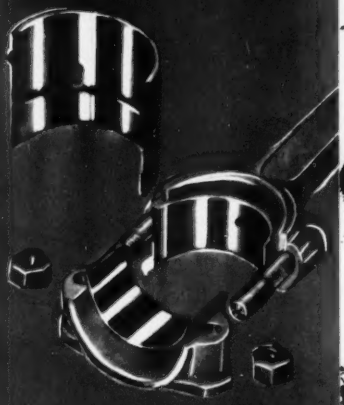

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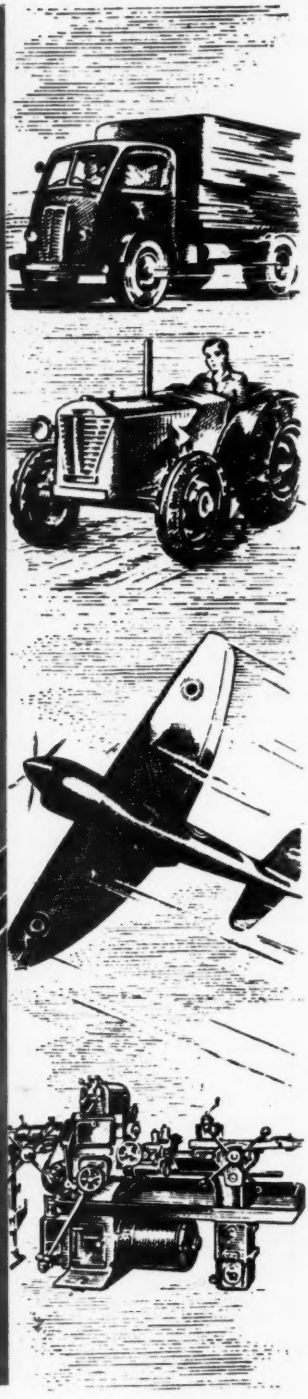
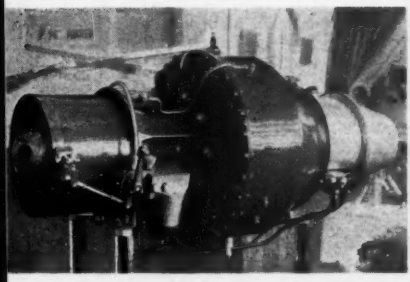
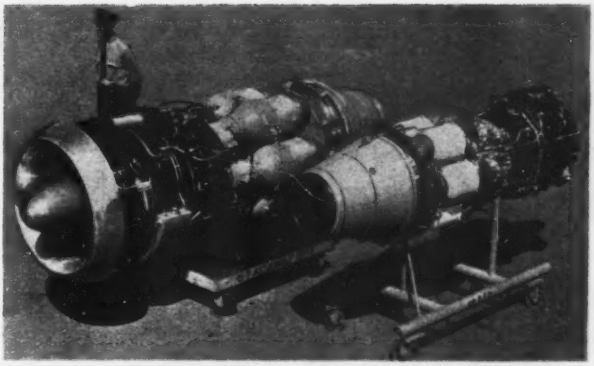
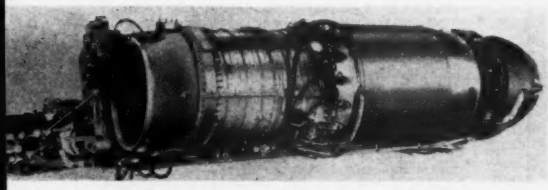




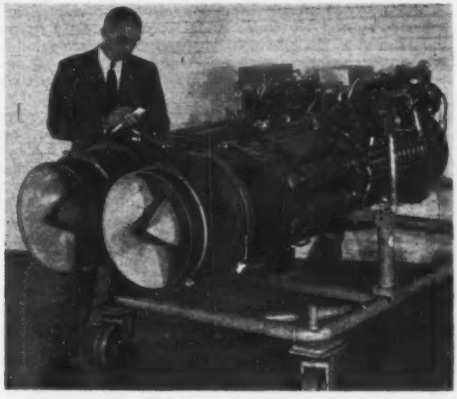


(Above) The 240-lb thrust Turbomeca Piméné. (Right) Comparison between the two Avro Canada turbojets—Chinook (2,600 lb thrust) and the larger Orenda, rated at over 6,000 lb.

JET PROGRESS ABROAD . . .



(Above) Latest of American turbojets to be revealed, the Westinghouse J-40 is of slim appearance. Thrust-output approaches 10,000 lb.



America's first coupled turboprop, the Allison T-40 (right), consists of two T-38s with common reduction-gear and extended airscrew-shaft.

6,250 lb, and is used in the F9F-5 Panther, F-93A Sabre and F-94C (advanced all-weather version of the Shooting Star). The American company has produced an effective afterburner of original design for the Tay. The Pratt and Whitney Nene, designated J-42, has seen action in Korea, powering Panthers of the U.S. Navy in several successful encounters with Communist Mig-15s. Development work is in progress now on two original Pratt and Whitney designs —a new axial-flow turbojet (J-57) and a powerful turboprop (the T-34, delivering 6,000 h.p.).

Another British unit hiding its light under an American designation is the Curtiss-Wright J-65—otherwise Armstrong Siddeley Sapphire. This powerful axial is to be built under licence for at least two U.S.A.F. types : the Martin-built Canberra and the new swept-wing F-84F Thunderjet (one has already flown in America with an imported Sapphire). Curtiss-Wright also hold licences to build the Python, Mamba, Double Mamba and the new Bristol Olympus.

The main "customer" of the Westinghouse Corporation, which completed its first gas turbine in March, 1943, is the U.S. Navy. Deck-landing fighters powered by 3,000 lb thrust Westinghouse J-24C axials include the Skyknight, Banshee, Pirate and Cutlass. The Skyrocket research aircraft has a similar unit. No details are available of the latest Westinghouse product—the J-40, a slim axial-flow unit which is reported to have a potential thrust rating in the region of 10,000 lb.

The Boeing Airplane Company is conducting research and development of small gas-turbine units, including the Model 500 small turbojet, rated at 190 lb, and the 200 h.p. Model 502 airscrew-turbine. Another comparatively low-powered turbojet (rated at 770 lb) is produced by the Flader concern as a power-unit for guided missiles.

Canada: In 1946 Avro Canada took over the Government-owned company of Turbo-Research, Ltd., and subsequently produced the Chinook, an experimental axial-flow turbojet rated at 2,600 lb thrust. From the Chinook has been developed the Orenda, which is a nine-stage axial-flow type of unit producing over 6,000 lb thrust. Other details are restricted. The Orenda has flown in a Lancaster test-bed and an experimental F-86 Sabre (aircraft of this type built under licence in Canada may have Orendas if present development continues satisfactorily). The Orenda is also to be installed in production versions of the Avro Canada Canuck twin-jet fighter.

France: The S.N.E.C.M.A. and Voisin works have, in collaboration, developed and built an airscrew-turbine, the TB.100, which gives 1,430 h.p. for take-off, and the Atar 101B, an axial-flow turbojet with annular combustion chamber rated at 4,850 lb thrust. Production, under licence, of the Rolls-Royce Nene and Tay is being carried out by the Hispano-Suiza company, and their first Tay is expected to fly in June in an experimental version of the Dassault Ouragan jet fighter. Most of the numerous French jet prototypes are powered by Hispano-built Nenes. The Rateau company began its research work on gas turbines in 1939, and continued clandestine development work during the German occupation. It is at present concerned primarily with the 8,800-lb-thrust SRA-101, an axial-flow design with ten compressor-stages. The first gas turbine of the S.O.C.E.M.A. company—the 3,000 h.p. T.G.A1 bis turboprop—was also developed during the German occupation. Annular combustion chambers and axial compressors are features of this and a second S.O.C.E.M.A. unit, the T.G.A.R.1008 turbojet, which is rated at 4,400 lb thrust.

Small, low-powered units are the speciality of the Turbomeca company, which began its post-war development

(*Continued on page 570*)

OUR CONTRIBUTION

How "Flight" Features Introduced and Made Familiar Gas Turbines and Jet Propulsion

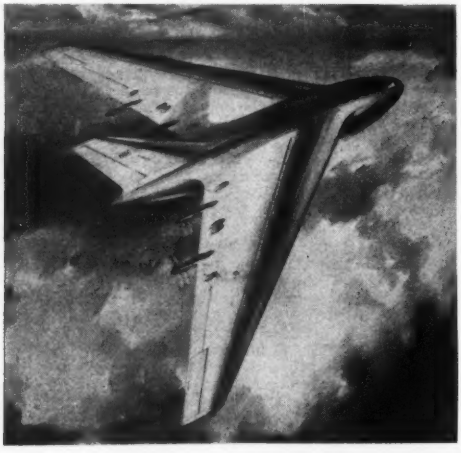
ALWAYS it is desirable not merely to keep abreast of progress but to endeavour to foresee developments. During the war, the staff of *Flight* was acquainted with the speculations and the rumours from abroad and sifted them meticulously. The need for a new type of aircraft power unit was under discussion and the potentialities of the gas turbine were being investigated. Reliable information was meagre, and diffused in pre-war papers delivered to learned societies. Mostly they referred to applications other than in aircraft. Jet-propulsion projects appeared to be of the most nebulous character and somewhat un-practical in conception.

We invited the late Dr. F. Lanchester to write four articles on the theory of exhaust efflux and jet propulsion, and these appeared during November and December, 1939. At that time, however, the situation was completely dominated by consideration of the development and production of conventional engines to meet the rapidly mounting needs of the Services.

Gleanings from the British and foreign Press, the printed lectures and the archives of the Patent Office revealed evidence of British, French, German, Italian, Swedish and Swiss interest in schemes of jet propulsion. We found that all Whittle's earlier patents had been published in the German journal *Flugsport* before the war. Rumours reached us that the Germans had actually flown a jet-propelled aircraft, but these could not be confirmed at the time.

In 1940 a decision was taken to extend the interest in this new sphere by publishing in the future a series of articles dealing with the principles of jet propulsion and of gas turbines, and reviewing such projects of power units and aircraft as were freely available. Soon afterwards there appeared in the *Popolo d'Italia* an account of a short flight by a Caproni aircraft with the propulsion system evolved by Campini. This was treated with reserve but was, apparently, authentic. On August 28th, 1941, appeared the first article by the Editorial Director, G. Geoffrey Smith, significantly entitled "Possibilities of Jet Propulsion." It briefly explained how a jet unit functioned, reviewed two Junkers projects for jet units and described the first Campini aircraft design. Subsequent articles dealt with Swedish,

Impression of a tailless airliner powered by four turboprop units submerged in the wing. (November 7th, 1946.)



Summary of Advantages of Jet Propulsion

(1) It would be less critical regarding fuel. Paraffins, diesel oils, tar oils can be utilised as well as, or possibly preferably to, petrol. So-called "safety" fuels could be employed without loss of efficiency. Solid fuel such as powdered coal cannot be ruled out as impossible.

(2) The power produced is applied in the best possible way, that is directly. No transmission or conversion mechanism is required. Thus cost, complication and certain energy losses are avoided

(3) Apparently the airscrew, as we know it to-day, will eventually limit the power which may be delivered by a single engine. Jet propulsion would eliminate the airscrew and avoid this potential handicap.

(4) Similar to the exhaust turbo-supercharger's superiority to the engine-driven supercharger in respect of maintenance of power at high altitude, jet propulsion would possess advantage over the engine-airscrew combination.

(5) By suitable proportioning of the components the main compressor system could also supply air to warm and charge a pressure cabin and prevent icing.

(6) It should be possible to use rotary components exclusively. As with steam plant this will enable higher operating speeds to be employed with a reduction of size and weight as compared with reciprocating units.

(7) Pressures are relatively low and casings and ducting therefore may be relatively light. Hence the power-weight ratio should be improved and speed and climb capabilities benefited.

(8) The absence of an airscrew enables the aircraft to be of low build. It may be possible to dispense with heavy and complicated undercarriages and retracting gears. Installation, servicing and stowage will be facilitated.

(9) Better location for the pilot can be arranged with an unrestricted field of vision. Similarly no obstructions for forward mounted armament on military machines.

(10) As plants can be completely enclosed in the fuselage or wholly or partially submerged in the wings, better structural form can be employed to reduce aerodynamic drag.

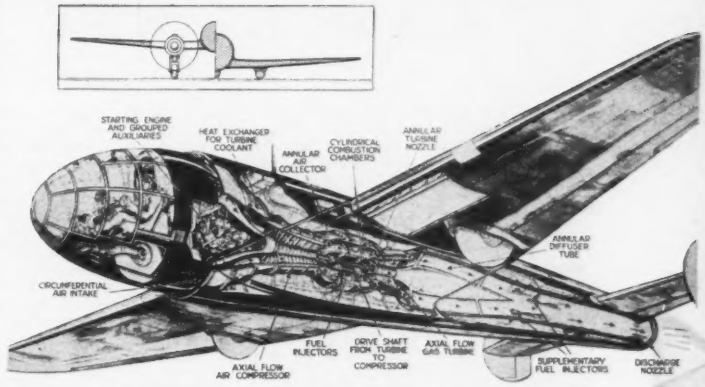
(11) Boundary layer pressure may be turned to account for the air intake. Possibly the propulsive discharge may be arranged to minimise or control boundary layer pressure over relatively large areas.

(12) For the larger aircraft, plants may comprise a number of units, each capable of independent operation but suitably grouped and interconnected. It thus becomes possible to cruise economically with less than the total number of units in operation under optimum conditions.

An expression of faith in the new method of propulsion. Twelve points (in panel above) on which "Flight" of October 9th, 1941, considered that the turbojet offered constructional and operational prospects of advance from current piston-engine standards.

Swiss and early Whittle turbojet designs, and the same French and British schemes using piston engines to drive the compressor.

So far we had reported designs, patents, projects and discussions. It was considered essential to bring the subject into practical relationship with current affairs. On October 9th, 1941, we published twelve points (reprinted here) epitomizing the potential advantages of jet propulsion, and also a drawing of a hypothetical jet-propelled aircraft. This was deduced from our study of the subject and tempered by our knowledge of current *desiderata*. At that time we had no information as to British activities and, of course, had seen neither a power unit nor an aircraft. We may be pardoned for a little pride in that flight of fancy. We plumped for a "straight-flow" arrangement with axial compressor, a series of cylindrical combustion chambers, a multi-stage turbine and afterburning equipment. The unusually low build of the aircraft, made possible by the absence of an airscrew, was emphasized in the small inset diagram.



This imaginative conception of a single-seater jet-propelled aircraft provoked tremendous interest when it was published. (October 9th, 1941).

The interest aroused was out of the ordinary, and our postbag was heavy with discussion and requests for further information. In response to this demand *Flight* published (in December, 1942) a book—*Gas Turbines and Jet Propulsion for Aircraft*—by G. Geoffrey Smith. This was the first on the subject in the world and the timeliness of its issue was immediately evident.

Throughout this informative campaign emphasis was given to the influence that the turbojet would exercise on aircraft design. Its reduced frontal area and slim contour would facilitate low-drag installation. The low weight and absence of vibration would permit lighter construction. The enhanced speed attainable would necessitate finer aerodynamic lines, absence of protuberances and better-finished skins. Particularly, it was suggested, the advent of the turbine would promote the development of high-speed tailless or even all-wing designs. This subject was featured on May 13th, 1943, and again on November 7th, 1946. An illustration from the last-mentioned article is here reproduced.

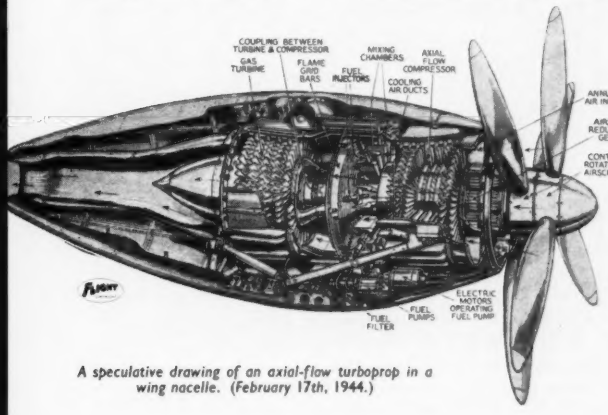
The first edition of the book *Gas Turbines and Jet Propulsion for Aircraft* was soon exhausted and an enlarged second edition was prepared early in 1943. It appeared in June of that year and was eagerly received. A second printing of this edition was ordered and was just coming off the press in January, 1944, when the existence of jet propulsion was proclaimed to a war-weary world. It will be recalled that a joint Anglo-American announcement on January 7th, 1944, revealed the adoption in Britain and America of jet-propelled fighter aircraft possessing phenomenally high speed capabilities.

Those were hectic days. The official disclosure was sparsely worded and all requests to Ministerial sources for additional information were turned by the suggestion that enquirers could find all that was permitted in *Flight's* book. At our office we were besieged by Pressman from the London, provincial and overseas newspapers clamouring for "background" and demanding to know "how it works." By urgent invitation G. Geoffrey Smith gave a talk over the Canadian Broadcasting Corporation network the same day and a few days later for the Home and Overseas programmes of the British Broadcasting Corporation.

The latest printing of the book was rapidly exhausted and a third edition appeared in April, 1944. Sir Frank Whittle informed us that it was an invaluable time-saver to him. He maintained a stack, and anyone who worried him for "gen" on the subject was presented with a copy and told he would find the complete story between its covers.

Flight continued to feature the gas turbine and on February 17th, 1944, discussed the prospects of the turbine-driven airscrew unit. For this article we essayed another imaginative drawing—this time of an axial-flow turbine mounted in a wing nacelle and driving counter-rotating airscrews. In due season all the ramifications of jet propulsion and turbine power units have been described and illustrated—pulsejets, ramjets, rockets, missiles, compounded units, ducted-and open-fan augmenters, and afterburners.

When the war ended, and the secrecy surrounding British activities was to some extent lifted, *Flight* was privileged to publish the first detailed description of the Rolls-Royce Derwent turbojet (October 25th, 1945), the de Havilland Goblin turbojet (November 1st, 1945) and the Lucas combustion- and fuel-control equipment (January 3rd and 10th, 1946).



A speculative drawing of an axial-flow turboprop in a wing nacelle. (February 17th, 1944.)

It remains to add that the *Flight* book *Gas Turbines and Jet Propulsion* now appears, much enlarged, in its fifth edition. Its fame has spread abroad and there are now American, Dutch, French, Italian and Spanish editions.

Countless engineers, works executives, students, and flying and Services personnel received their introduction to the subject from this work. It has been adopted, both at home and abroad, as the standard text for a number of colleges and training establishments. In a message welcoming the fourth edition, in August, 1946, Sir Frank Whittle stated: "In recent months there has been ample evidence of intense interest in jet propulsion and the aircraft gas turbine. I have no doubt that much of this interest has been aroused by the earlier editions of this book."

F. C. S.

GAS-TURBINE SCHOOL

Work of the Unique Power Jets Establishment at Farnborough

THE creative work of Sir Frank Whittle's original group of designers and engineers has now been long completed, and Power Jets (Research and Development), Ltd., exists for a changed purpose—to exploit, for the nation, British gas-turbine patents. One direct offshoot of the pioneer organization, however, still flourishes: the School of Gas Turbine Technology, now situated at Farnborough.

The School was formed in 1943 to help in the training of Servicemen responsible for carrying out the transition from airscrew-drive fighters to jets. By 1946, this work had been taken over by the R.A.F., and the School was "demobbed" to play a comparable part in industry; it was taken over, in 1946, by the National Gas Turbine Establishment—which, of course, still exists and does vital work, now mainly of a secret nature. In 1948 the School was again transferred into the hands of Power Jets (R. and D.), Ltd.

Its function was (and remains) not only to assist the aircraft industry in building up the teams of gas-turbine specialists demanded by the adoption of a new prime mover, but to pass on to other branches of engineering improved techniques developed for aviation but applicable to a wider field.

In the words of Mr. D. L. Brown, A.M.I.C.E., M.I.Mech.E., the School's Principal: "Gas turbine technology is probably the widest single field of mechanical engineering that has ever been studied . . . we in the United Kingdom have an enormous manufacturing potential, probably more fundamental technical and intellectual knowledge, and certainly as much ingenuity, as any other country." He further contends that "if adroitly and rationally handled, this knowledge and expérience can and will form the basis of an important national industry: so much so that in a few years' time we should lead the world, just as in the past, we have led with our railways, iron and steel, ships and steam turbines."

For the heavier branches of engineering, the School offers a three-week industrial course, during which its own comprehensive training facilities are supplemented by visiting specialists. Lectures cover basic design theory, application of various cycles to numerous industrial uses—electric-power generation, locomotives, ships and road transport. Other industrial subjects are the coal-fired gas turbine, economics and heat-transfer.

Firms and Government organizations connected with aviation normally send representatives to the aero-engine design or practical courses. The former, lasting a fortnight, attracts post-graduate students from such varying bodies as the B.O.A.C. Comet Unit, Boscombe Down, the A.I.D. and the Bristol Aeroplane Company. Students cover a great deal of ground during this course—subjects include basic thermodynamic theory, design of compressors and turbines, materials and manufacturing techniques and performance-analysis. Practical illustration is provided by actual power-units—including Goblin, Derwent and Theseus—and by outside visits to the nearby National Gas Turbine Establishment laboratories at Pyestock and the former Napier test-house at Acton, where test-runs are made with a W 2/700 turbojet and Naiad turboprop.

Performance, maintenance, installation and inspection are the main concern of the practical course, whose members spend much of their fortnight at Acton working on a Meteor.

The export value of British gas-turbine "know-how" is not neglected, and courses for overseas students are periodically organized. One such course attracted 34 pupils from abroad, representing 14 different nations. This year, the two international courses have been prudently timed: one, now in progress, coincides with the opening of the Festival; the second, in September, with the adjacent S.B.A.C. Show.

All four courses are most intensive, and students normally live-in at the School. Domestic conditions in this former manor-house are exceptionally comfortable, and, combined with a high standard of technical instruction, have helped to establish the School's reputation at home and abroad.

JET PROGRESS ABROAD (Continued from page 567)

work in 1947. The Piméné, the firm's first turbojet, has performed well in the air as power-unit for the Fouga Sylphe powered glider, and has completed type-tests under I.C.A.O. conditions at a maximum rating of 242 lb static thrust. Features of its design are a single-stage radial compressor and annular chamber with rotary fuel injection. Other lightweight units produced by this company are the Orédon (140 h.p.) and Artouste (220 h.p.), which may be employed for aircraft propulsion or auxiliary drive. The Turbomeca Aspin (thrust 440 lb) incorporates the ducted-fan system of thrust augmentation.

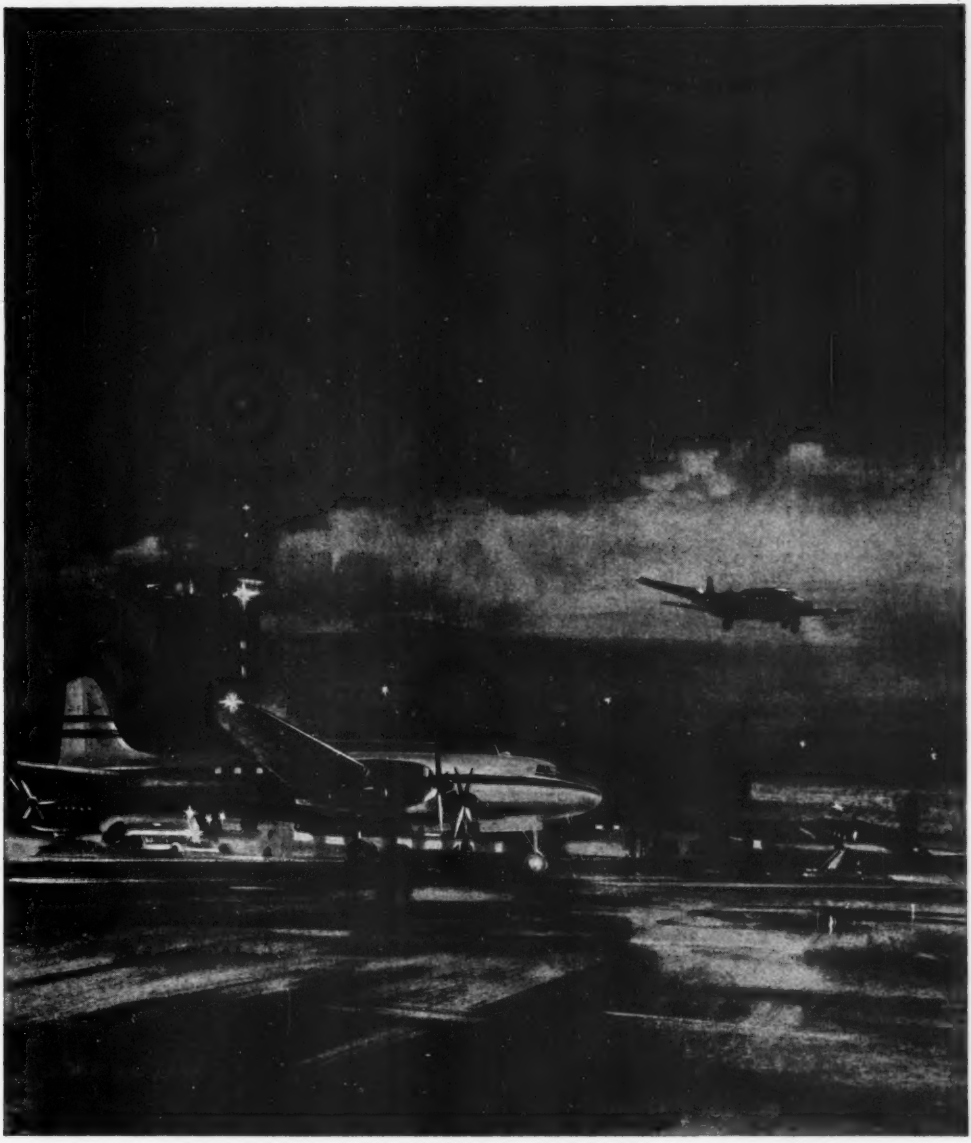
Sweden: The Svenska Turbinfabriks company has developed a 3,200-lb-thrust turbojet, the Skuten—designed by Mr. A. Lysholm, who produced designs for aircraft gas turbines as early as 1936. Licences for building the Goblin and Ghost are held by the Svenska Flygmotor concern.

Russia: Of her engine development, as with other branches of aviation, Russia has revealed no details. Such scanty information as is available indicates two trends: design of axial-flow turbojets based on German experience with this type, and development on the lines of the Nenes and Derwents exported to the Soviet in 1946. So far, however, there seems to be no definite authority for reports that the high-performance Mig-15 jet fighter is powered by a Nene-type turbojet.

GAS-TURBINE PROGRESS ABROAD: AVAILABLE DATA ON CURRENT TYPES

Country and make	Type designation	Max. power Max. thrust	Shaft h.p.	r.p.m.	Cruising power (lb thrust)	Comp. type	No. of chambers	Diameter (in)	Length (in)	Weight (dry, lb)
AMERICA:										
Allison ...	T-38	415	2,750	—	—	A	8	20	84	1,225
do.	T-40	830	5,500	—	—	A	2 x 8	39	84	2,500
do.	J-33	5,400	—	11,750	3,600	C	14	50·5	103	1,795
do.	J-35	5,000	—	7,800	4,000	A	8	37	146	2,260
Boeing ...	Model 500	190	—	38,000	165	C	2	22	29	111
do.	Model 502	50	200	2,700	25*	A	2	22	42	184
Fiader ...	J-55	770	—	28,600	700	A	Ann.	15·75	79	300
General Electric	J-47	5,200	—	7,950	—	A	8	36·75	144	2,500
do.	J-53	10,000 (appr.)	—	—	—	A	—	—	—	—
Pratt & Whitney	J-42 (Nene)	5,000	—	12,300	—	C	9	49·5	101·5	1,715
do.	J-48 (Tay)	6,250	—	—	—	C	9	—	—	—
do.	T-34	—	5,700	—	—	A	Ann.	30	155	2,550
do.	J-57	10,000 (appr.)	—	—	—	A	—	—	—	—
Turbodyne ...	XT-37	600	10,000	—	*	A	Ann.	—	—	—
Westinghouse	J-34	3,000	—	12,000	2,290	A	Ann.	27	120	1,200
do.	J-40	10,000 (appr.)	—	—	—	A	—	—	—	—
do.	J-65 (Sapphire)	7,200	—	—	—	A	Ann.	32·25	133·85	2,500
CANADA:										
Avro Canada	Chinook	2,600	—	10,100	1,900	A	6	32	125	1,250
do.	Orenda	6,000*	—	—	—	A	9	—	—	—
FRANCE:										
Snecma ...	TB. 1000	570	1,370	15,400	420*	A	6	27·5	107·5	1,060
do.	Atar 101B	4,850	—	8,050	4,400	A	Ann.	34·9	112	1,875
Rateau ...	SRA-101	7,275	—	9,500	8,800	A	12	43·25	143·7	2,200
Socema ...	TGA1 bis	1,210	2,420	6,550	1,100*	A	Ann.	45·3	120	4,630
Turbomeca ...	TGAR 1008	4,850	—	6,600	4,190	A	Ann.	40·5	153·5	2,750
do.	Piméné	242	—	35,000	176	C	Ann.	16	32	118
do.	Aspin	440	—	36,500	—	C	Ann.	23·6	—	264
SWEDEN:										
Svenska Turbinfabriks AB	STAL Skuten	3,200	—	—	—	—	—	—	—	1,720

* Units marked thus are turboprops, with shaft power (cruising) as follows: Boeing 502, 108 h.p.; Turbodyne XT-37, 8,000 h.p.; Snecma TB. 1000, 940 h.p.; Socema TGA1 bis, 1,970 h.p.



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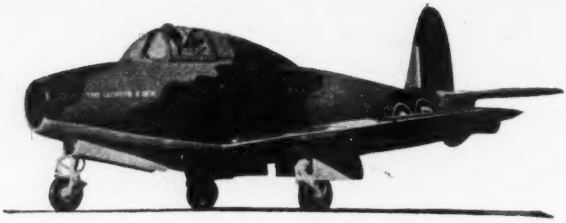
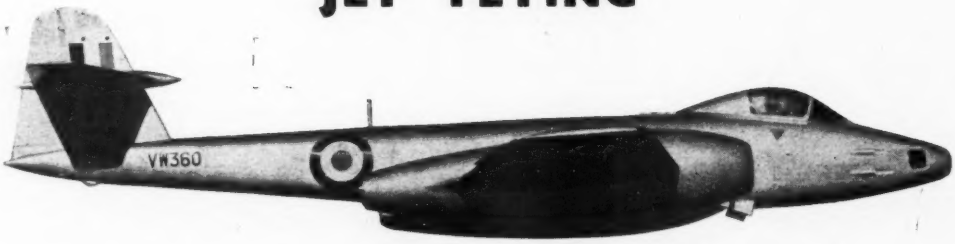


IN 10 YEARS OF HIGH-SPEED JET FLYING



Docker Brothers are proud of their close association with the Gloster Aircraft Company and have been privileged to supply the high-speed finishes of exceptional aerodynamic cleanliness and durability for all Gloster Aircraft from the historic Gloster-Whittle E28/39 to the latest Meteor. A decade of aeronautical endeavour and achievement without equal.

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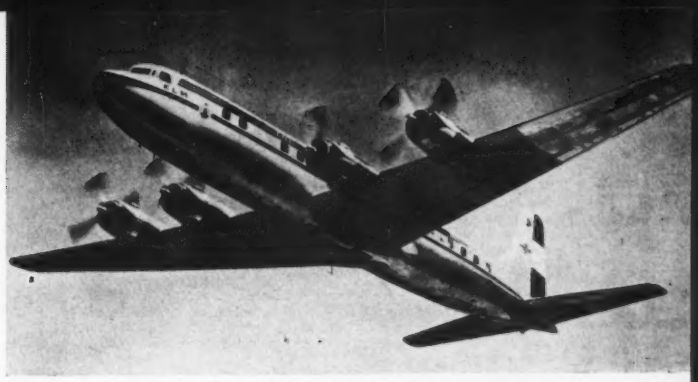
CIVIL AVIATION



CONFIDENCE IN THE FUTURE: With its existing order for five DC-6Bs now increased to seven (see this page) and nine Super Connies similarly earmarked, K.L.M. seems to be expecting a profitable future. We reproduce what is termed a "photographic impression" of the DC-6B as it will appear in K.L.M. livery.

K.L.M.'s FLEET GROWS

WITH the confirmation of an order for two additional Douglas DC-6Bs and four additional Lockheed L-1049C Super Constellations, the Dutch airline, K.L.M., has now given a further indication of the fact that it means to carry out a full re-equipment programme. This further order is said to have resulted from the satisfactory traffic trend which is now being experienced. The company's total requirement is now for seven DC-6Bs and nine Super Constellations; they will be delivered in 1952 and 1953 respectively.

The decision to order further aircraft was carried out after consultation with the Netherlands Government and the transaction will be financed out of amounts which are to be written off for depreciation.

T.A-A. TURNS INTERNATIONAL

TRANS-AUSTRALIA Airlines may shortly begin their only service to a foreign country if plans now being made for a regular flight from Darwin to Portuguese Timor are successful. The distance is about 400 miles. It is known that Portuguese living in Timor have often complained of their isolation and are anxious to have such a service started.

Although the crossing of the Timor Sea—notorious for its shark-infestation—is considered rather more hazardous than normal civil operations, these flights are regularly made by military and other aircraft in the DC-3 category. A survey of facilities at Timor has already been carried out by Australian civil aviation authorities using an R.A.A.F. transport aircraft, and prospective airfields at Baucau and Dilli have been examined. It is conceivable that if hotel accommodation at these points is suitable Portuguese Timor may eventually become a tropical holiday resort for Australians, particularly those residing in the Northern Territories.

UP AND DOWN

B.O.A.C. last week announced several changes in the frequency of their summer services. In most cases the changes are intended to provide additional capacity for visitors to the Festival of Britain. The Monarch flights, operated by Stratocruisers, are now being flown daily between New York and London instead of five times a week as under the previous schedules, while two of the other five Stratocruiser services a week between these two points are being routed to call at Boston.

From May 1st, also, flights between London and Montreal were increased from three to four a week, one being direct and the other three calling at Prestwick. In addition, the London-Nairobi service is now being operated daily instead of four times a week. In general heavy bookings are reported on services from Australia and South Africa, mostly by passengers for the Festival.

Other sections of the Corporation's route structure, however, are not faring so well and, in fact, severe competition on South American routes has forced B.O.A.C. to withdraw the service down the west coast to Santiago, Chile. In the first 11 months of the financial year 1950/51 B.O.A.C.'s South American routes lost £2,120,000, more than a half of this deficit being incurred on the West Coast service alone. This route now terminates at Jamaica.

SPEAKING OF BUGS

ATTENTION was focused on the subject of airport quarantine regulations at a conference of South Pacific operators held recently at Suva, Fiji, speakers submitting that the spread of plant and animal disease throughout the area could be postponed indefinitely if interested governments were to enforce stricter regulations at airports. Among the forms of treatment on which agreement was reached were the provision of adequate fumigation and incineration facilities at airports, together with improved insecticidal spraying of arriving aircraft. Quarantine measures will in future be applied to all aircraft, whether military or civil. It was recommended also that care should be taken not to plant near to an airport trees or gardens which include plants known to be "hosts" to certain insects and bacteria.

Each government was called upon to prepare a list of local plant and animal diseases against which precautions must be taken, and the compilation of monthly returns was called for to keep these lists up to date. Members of the conference, among whom delegates from New Zealand were prominent, expressed serious concern at the problems which arose from the importation of fodder, straw and packing materials for a large range of goods; "rice straw" was recommended for total exclusion from all territories.

It seems, however, that bugs (not of the abstract variety) are not always carried in aircraft unintentionally. United Air Lines recently flew 5,000,000 baby ladybugs (ladybirds to us) packed in 66-gall cans from Sacramento, California, to Armarillo, Texas. The larvae, which are obtained from Californian mountain slopes and are sold at $3 a gallon, are used by Texas farmers to keep their crops free from scale and aphis.

PANAGRA'S IMPROVED RESULTS

PANAGRA is reported to have flown 31,467,000 passenger-miles during the first quarter of this year, a 30 per cent increase over the total for the corresponding period of 1950. This is in marked contrast to the 1949-1950 period, when practically no improvement was apparent.

The company, which provides the principal service linking the United States with the west coast of South America, now has six DC-6s, four DC-4s and ten DC-3s in operation. Two DC-6Bs will be added to the fleet early in 1952.

Panagra was formed in 1929, Pan-American Airways and

ARIEL AIRBORNE: The French S.O.1120 "Ariel III" turbine-powered helicopter made its first flight on April 19th at Villacoublay. Development has apparently been rapid, since the order for its construction was placed only last June. The power unit is a Turbomeca Artouste of 220 e.h.p.

CIVIL AVIATION . . .

W. R. Grace and Co. each putting up $500,000 (about £180,000). No financial statements are published by the airline, since there are no public holdings of shares, but according to the *Wall Street Journal* it is known that the two owners have received about $2,000,000 (£700,000) in dividends since the company started, or about double their investment. At the same time, the net value of the business has increased to some $8,900,000 (£3,100,000). No dividends, however, have been paid since 1945.

Panagra borrowed $4,000,000 (£1,400,000) in 1946 for modernizing its fleet of aircraft, and about $1,200,000 of this sum is said to remain outstanding; it is expected that it will be paid off by early next year.

BREVITIES

THE M.C.A. has now certified the airfield at Walney (Barrow-in-Furness) for use as a public airport. To be operated by the Barrow-in-Furness Municipal Corporation, the airfield has three tarmac runways, the longest of which measures 13,000 yd.

* * *

The Aerodrome Owners' Association has decided to hold its annual conference this year in Bristol. It will probably last two days and will take place early in September.

* * *

A DC-3, equipped with a magnetometer, is being used by the Australian Government for oil-prospecting flights in the Lake Wellington area.

* * *

Australian National Airways have estimated that since 1936 their aircraft have carried a passenger-total (4,150,000) which represents half the population of Australia. The passenger-mileage figure for this period is two billion and the 217,000,000 lb of freight lifted is equal to about 30,000 DC-3 freighter-loads.

* * *

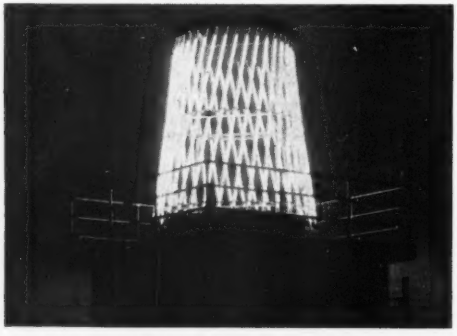
Indicative of the growing travel business to Japan, both commercial and tourist, is the expansion of Philippine Air Lines' service to two weekly flights between Manila and Tokyo. DC-6 flights are scheduled via Okinawa, while a DC-4 service is routed through Taipeh, which is the centre of the Chinese Nationalist Government's activities.

* * *

The Swedish airline, A.B.A., which in February was amalgamated with the Danish and Norwegian companies making up the Scandinavian Airlines System, reports a profit of Kr. 10,700,000 (£738,000) for the period July 1st, 1949 to September 30th, 1951. The average total of employees during this period was 1,999.

* * *

Three Curtiss Commandos owned by Civil Air Transport, an American company operating in the Far East, are now on their way to New Zealand to help cope with the rapidly increasing traffic on the Cook Strait air-freight service which links the North and South Islands of that country. Bristol Freighters will be introduced on June 1st, when these operations—at present run by the Railways Department—will be taken over by a new private company, which is actually a subsidiary of Airwork, Ltd.



THE LIGHT OF LONDON : A new 7 kW identification beacon employing mercury-filled cold-cathode fluorescent tubes has been added to the navigational aids at London Airport. It was made by G.E.C., to an M.C.A. specification. The 36 tubes, which are each 30 mm in diameter, have a total light output of 180,000 lumens.

AMPHIBIOUS AMBULANCE : Before its departure last week for service in Norway, this Short Sealand acquired by Vestlandske Luftfartselskap gave a practical demonstration of the ease with which a stretcher and patient can be loaded.

During the year ended March 31st, B.O.A.C's station at Miami, Florida, handled the record total of 24,025 revenue passengers; most of them were American tourists who were flown to destinations in the Caribbean.

* * *

Following the runway improvements at Harewood airport, Christchurch, Tasman Empire Airways are preparing to operate direct services between Christchurch and Melbourne. They will probably start with DC-4s and subsequently replace them by DC-6s.

* * *

With the introduction of the new summer schedules, which became effective on April 29th, a total of 22 daily flights have been added to T.C.A.'s domestic services. Particularly heavy seasonal traffic is expected to develop this year and other flights will be added in June.

* * *

B.E.A. are meeting an ever-increasing demand from shippers for cargo space on their extensive network of regular European routes. The annual total is now said to have reached 9,000 tons, and this summer the Corporation has scheduled 22 freight services weekly out of Northolt to serve ten European centres, in addition to 12 flights a week on the freight ferry between Berlin and Hamburg and two extra ferry flights a week between Rome, Milan and London.

* * *

Silver City Airways report that advance bookings received up to April 30th, for the Lympne-Le Touquet Car Ferry were 180 per cent ahead of last year's figure. Motor-cycle bookings, particularly, have shown a striking increase from a mere handful in 1950 to 1,700 so far this year. On April 29th the Minister of Civil Aviation, accompanied by Lady Pakenham, inspected the facilities at Lympne, where a new Customs-and-passenger building was recently erected.

* * *

In recent months United Air Lines personnel staff have been mystified—though not displeased—by an unaccountable lengthening of their stewardesses' average terms of service. Previously the girls were resigning—almost always to marry—within 18 months of acquiring aircrew status; now the period has risen to 29 months.

* * *

Prestwick Airport has just lost a customer to Renfrew. Air France, who have operated seasonal services through Prestwick for the past four years, have decided to make Renfrew their Scottish terminal this summer. From next month they will operate a thrice-weekly service linking up with their London-Paris "restaurant" flight. A charter company, using Vikings, will operate the Renfrew route because the French company has insufficient crews.

* * *

During the first three months of this year some 88,000 overseas visitors arrived in the United Kingdom, as compared with 78,000 for the corresponding period of last year. The British Travel and Holidays Association reports, however, that American tourists are still somewhat reluctant to make advance bookings "in the light of world events". In view of the unsettled international situation, the Association considers that the present figures are "relatively satisfactory". B.O.A.C. report, incidentally, that of the 250 passengers per day now reaching London in the Corporation's aircraft, a high proportion are Festival visitors.

THE PASSENGER THINKS ALOUD

Candid Comments on Airline Comfort Emerge from R.Ae.S. Discussion

As briefly mentioned in our columns last week, the closing event of the Royal Aeronautical Society's spring lecture session was a discussion entitled *Air Travel from the Passenger's Point of View*. In the chair was the Society's President, Maj. G. P. Bulman, C.B.E., F.R.Ae.S., who introduced the first two speakers.

The discussion was opened by MR. HUNTINGTON, who, as a King's Messenger, had completed over 8,000 passenger hours per annum since 1947. His first remarks concerned the wide variations in passenger-handling standards between airports throughout the world, and even between those situated as closely together as London Airport and Northolt. The latter emerged most favourably from his comparison; at Northolt, fewer staff appeared to him to give better attention.

He considered seat design to be most important. Full reclining adjustment was particularly necessary for long trips; it was still not always provided. The Argonaut seats, for example, were tiring : they were narrow, there was insufficient room to stretch one's legs, and one's head could too easily fall to one side during sleep. (It was explained by a subsequent speaker that the design of the present seat was limited by the original layout of the aeroplane, but that a new and greatly improved type of seat was shortly to be introduced.) The Argonaut's pressurization system was very good, although inadequate humidification caused one's skin to become very dry during a long flight.

On American airlines, all seats allowed full reclining and the leg-room was adequate. During night flying, also, the cabin lights were dimmed, but not extinguished, and thus passengers were not suddenly awakened, just before landing, by the full brilliance of the lights.

Mr. Huntington concluded with some remarks on his experience of Russian aircraft, which, he said, were excellent, and their pilots good. Safety precautions had at one time appeared negligible, but had now been improved; he remembered cases of inefficient cargo lashing, and of smoking during refuelling. The Russian IL-12 transport was slow but very comfortable.

LADY DOUGLAS, the second speaker, considered that the steward or stewardess could make or mar the trip, and that, in the matter of individual preference for the attendant's sex, men on the whole preferred stewardesses and women preferred stewards. The only satisfactory solution seemed, therefore, to carry one of each !

When the crew was faced with an emergency the best plan was to tell the passengers the truth, thus engendering confidence in the crew. The personal touch was most important, and she would be disappointed if the increasing size of future aircraft made its provision impossible.

It was also important that aircraft should not be overcrowded. All seats should be adjustable and should be fitted with tables; she would also like to see each seat fitted with a built-in mirror, preferably with a pocket containing face-tissues. (The seat-mirror question attracted several subsequent speakers, the chief objections cited being weight and cost.)

Lady Douglas pleaded for larger windows; the travelling public should be encouraged to enjoy such delights peculiar to air travel as cloudscapes, sunsets and the excitement of approaching a strange country from aloft. Regarding catering, hot foods and beverages went far toward reducing the tired, nervous state. While cold meals might still be served, hot soup should be included.

MR. GEORGE EDWARDS (Vickers-Armstrongs, Ltd.), unlike Mr. Huntington, considered that recent American standards of passenger comfort were lower than those provided by some contemporary British aircraft. With regard to seats, Mr. Edwards said that no other part of the aircraft had so much time spent on it in doing it the wrong way ! He wondered which was most desirable—cheapness, comfort or safety. If the last, then on a certain aircraft seats strong enough to withstand 15g might entail a payload penalty of about 700 lb.

LORD DOUGLAS OF KIRTLESIDE (chairman of B.E.A.) could not understand why such a simple thing as producing a suitable seat should be considered so difficult. He was sure he could do it on his head if he tried ! In his experience, the handling of passengers at American airports left much to be desired, although their stewards and stewardesses were excellent. On the subject of noise, which he regarded as the most tiresome aspect of air travel, he was surprised that Mr. Edwards had not mentioned a certain new aircraft of his, which was exceptionally good in that respect.

MR. A. C. CAMPBELL-ORDE (B.O.A.C.) pointed out that foreign passengers also had their individual points of view, and this was only one of the airlines' many difficulties in conducting passenger research. Another problem was the increasing number of children of all ages who were becoming air travellers. They were getting increasingly difficult to control, and passengers' complaints might necessitate the isolation of children in future.

MR. S. SCOTT-HALL (M.o.S.) thought that "mental comfort" was much more important than physical comfort. Crews should be trained to inspire confidence and to reassure passengers. The progress of a ship at sea was easily understood, but it was extremely difficult for the air traveller to appreciate the reasons for the motions of an aircraft whilst "stacking" or awaiting recognition by G.C.A.

MR. PETER MASEFIELD (chief executive, B.E.A.) said that the job for which airlines existed was to provide improved communication facilities combined with safety, regularity and frequency. He considered the aircraft used should be the biggest ones the operator could fill at the right frequency. He was not "sold" on rearward-facing seats, as it did not seem the ideal arrangement to have a door at the back and a lot of goggling eyes facing the passenger when he went in. The great thing, of course, was not to have accidents.

For the development of aircraft seats, B.E.A. had a fine test team equipped with a wide variety of anatomies. It was led by their chairman, Lord Douglas, and continued down the scale to the lowliest office boy !

In the matter of windows, he felt the rest of the industry was lagging behind Mr. George Edwards's latest products, which provided passengers with unequalled view. On the subject of turbine noise, one particular type known to him was so shattering when running on the ground that it was certain to clear the tarmac of people when it came into service. Speaking of helicopters, Mr. Masefield mentioned a certain bishop who was a regular passenger on B.E.A.'s Welsh service. He had enquired what would happen if the engine stopped. To this, they had only been able to reply that he should "have faith" !

Mental Reactions

MR. BUSTARD (B.O.A.C.) considered that mental discomfort was much more trying to the passenger than noise. The majority of air passengers were slightly uneasy, largely as a result of the unfamiliar surroundings. The routine of tightening safety-belts, demonstration of life-jackets and pointing out emergency exits resulted in a slight tensing effect on the body which undoubtedly caused fatigue.

MR. C. G. GREY said that he preferred, when travelling by train, to sit with his back to the engine. Should the brakes be applied suddenly, he would be pressed fairly evenly against the seat back, and could at least break the impact of the passenger from the seat opposite by thrusting both hands in his face !

He quoted a remark once made by Alex Henshaw, to the effect that flying was the quickest way of getting about the world—if you weren't in a hurry ! He deplored the fact there was no airport in the world at which a bath was obtainable, and, in fact, he knew of no London hotel providing this urgent requirement of the overnight air traveller—at least, not until midday.

MR. LOBLEY (B.O.A.C.) mentioned the space limitations which still existed, even in certain recently re-equipped aircraft, which proved embarrassing to long-legged passengers. The great efforts nowadays expended on seat development did not include a period of observation under service conditions—for example, by watching a seat's performance during a trip half-way round the world, in order to determine its suitability.

CAPT. J. LANKESTER PARKER claimed to be "an exceptionally nervous passenger," for reasons which another speaker had given. Nevertheless, taking the present Belfast-Northolt service, for example, which was operated by perhaps the oldest of the aircraft at present in regular British use, he still considered it much better from the passenger's point of view than any alternative means of travelling. He expressed his feelings on the question of rearward-facing seats—the main objective was, after all, not to crash. This was a much better thing than to survive a crash in rearward-facing seats only to be burnt up—a far greater danger. He also felt much safer with a tricycle undercarriage than with the older tailwheel type.

MR. J. S. SHAPIRO drew attention to the effect of a passenger's surroundings on his sensitivity to vibration; tests had shown that a degree of vibration apparently negligible in an elderly car was in fact most noticeable in a modern helicopter. He felt that

CIVIL AVIATION . . .

perhaps speed as such was being taken for granted by passengers, and wondered if two classes of air travel should be provided—an "austerity" class for those who paid for themselves, and a class with greater comfort for those who travelled at their firms' expense. On the relationship of safety to comfort and economy, he considered that the degree of safety provided should not be left to the individual designer to assess, but should be prescribed by some public authority.

MAJOR BULMAN, in summing-up, quoted an old saw to the effect that the mind could comprehend only so long as the seat was comfortable. He felt that the increasing efforts toward personal comfort were a good index of the progress and the present state of air transport. In contrast, he recalled a serious suggestion of some years ago that passengers should be doped and then transported in specially designed racks!

The President finally expressed the great regret of the Society that the retiring secretary was that evening stepping for the last time from the rostrum.

CAPT. J. LAURENCE PRITCHARD acknowledged well-earned applause, regretting that the time available did not permit him to express some quite forcible opinions from the passenger's point of view.

CLUB AND GLIDING NEWS

THE improved accident-rate which has resulted from the adoption by British flying clubs of more efficient operational methods and standard practices evolved by the A.B.A.C. has now allowed reductions to be made in the premiums for club members' personal accident insurance. A new scheme recently negotiated by the A.B.A.C. with Lloyds underwriters enables club members to insure themselves against death or injury at a premium of £1 per year for each £1,000 insured, a figure which represents but a fraction of that prevailing before the last war.

The Association has expressed the view that the new insurance scheme is of the highest importance, both as an indication to the public that the insurance market now considers the risks of club flying to be almost negligible, and also in helping to bring flying within the reach of many people who previously were deterred by the high cost of personal insurance.

THIS year's navigation competition for the Ragosine-Auster Homing Trophy will take place on Sunday, June 3rd, starting and finishing as usual at the Auster airfield at Rearsby. It will be on similar lines to the competitions held in previous years, i.e., it will be a practical exercise in solo cross-country navigation.

The Trophy itself is a large silver bowl, suitably inscribed, which is held by the winner for 12 months. A silver replica of the bowl is also awarded as a permanent memento. For the past three years the Trophy has graced the club-house of the Brough Flying Club, but the challenge from other clubs and from private pilots is expected to be stronger than ever this year.

The competition is open to all pilots of Auster aircraft, and there is no entrance fee. General rules and entry forms will be available shortly and may be obtained from the Auster Flying Club, Rearsby Airfield, Leicestershire.

It should be noted that the day preceeding the event, Saturday, June 2nd, is the occasion of the Auster Club's annual air display and the organizers hope that many visitors will "make a week-end of it".

THE London Aeroplane Club held its annual general meeting at Panshanger Airfield on April 29th. The assembly followed a most successful breakfast patrol in which, with ten defending aircraft, the club intercepted 18 of the 39 visiting invaders.

Giving his report on last year's activities the chairman, W/C. C. A. Pike, said that the total of hours flown had reached 1,650 and that membership had risen to 220. During the year, in which the training of A.T.C. cadets was also begun, the club had gained nine Private Pilots' Licenses; a further ten had been awarded in the first four months of the current year. Two Instructors' Endorsements were also obtained.

The club fleet now comprised four Tiger Moths, three Hornet Moths, a Moth Minor Coupé, an Auster Autocrat, and a Chipmunk (another is expected), while members had the use of a privately-owned Moth Minor belonging to Mr. John Cooper. The new club-house, hangar and workshop were also mentioned as being welcome innovations during 1950.

Notable events of the year said W/C. Pike, had included the de Havilland Technical School Parents' Day last summer and the ball held at Londonderry House just before Christmas. Among individual achievements, there had been the creditable performances of Mr. Pat Fillingham and Mr. John Brown, who respectively flew the Moth Minor Coupé and Chipmunk in the *Daily Express* South Coast Race. The chairman announced that for this year's King's Cup Race the Moth Minor Coupé is to be flown by Mr. Brown, the Chipmunk by Mr. Hilton and the second Chipmunk (if ready in time), by Mr. Martin Sharp; Mr. John Cooper will pilot his own open Moth Minor.

During a discussion of future events it was apparent that all members were very interested in the idea of a summer dance, which it is hoped will be held locally. For this occasion the Club will join forces with the de Havilland Technical School and its Old Boys' Association.

RECORD BREAKER: A new British gliding distance record was set up on May 2nd by F/L. A. W. Bedford, A.F.C., of the R.A.E., Farnborough. He flew 250 miles in an Olympia to his declared destination, Usworth airfield (near Newcastle-on-Tyne), in 6¾ hr, thus beating the previous record of 232 miles established by Mr. Philip Wills. F/L. Bedford is here seen with an Olympia belonging to E.T.P.S.

THE picturesque island of Sicily will be the venue for the three-day international rally which is being organized for June 8th to 10th by the Aero Club of Palermo. Known as the Third International Air Circuit of Sicily, the event is open to a maximum of 35 aircraft; they must be multi-seaters and have a cylinder displacement of not exceeding ten litres if single-engined, and not more than 6.5 litres if twin-engined. (The two Cirrus Minors of a Miles Gemini, for example, have a displacement of 7.98 litres.)

Cash prizes totalling 3,100,000 lire will be awarded. The entry fee is 4,000 lire (approximately £2) and application forms may be obtained through the Royal Aero Club.

PRELIMINARY details have now been received of the International Air Rally of Spain, which is to be held from June 8th to 15th. It will mark the inauguration of the new club-house and airfield of the Royal Aero Club of Spain. Approximately 50 aircraft will be permitted to take part, the number of entries from each country being allocated in relation to the number of applications received.

Entry forms should reach the Royal Aero Club by May 15th. Participants will be the guests of the Royal Aero Club of Spain and, it is stated, will not incur any expenses for accommodation, for handling of their aircraft or for the various forms of entertainment which are being planned. It is intended that the rally should start from Bilbao and be routed *via* Madrid and Seville, returning to Madrid and ending at Logrono.

THE British Gliding Association's regulations for the National Gliding Championships (Great Hucklow, July 21st-29th inclusive) are now available. Eligibility rules for pilots include possession of a "C" certificate; a total of at least 20 hours solo (including five hours of hill-soaring) in gliders of up to 1,250 lb a.u.w.; completion of a cross-country flight of at least 50 km; and possession of a valid F.A.I. competitor's licence. The championships are open to all types of gliders, which will be handicapped in three categories based on aspect ratio. The contests will be divided into two categories, a team class in which two or more pilots must be nominated and also an individual class.

The regulations and entry forms are obtainable from the British Gliding Association at 19, Park Lane, London, W.1. Entries close on June 16th or, at an extra fee, on July 7th.

Operational area a hemisphere!

Defence strategy must today be conceived on a world-wide scale. Modern warfare, fluid, complex and mobile, can range from densely-populated areas to isolated atolls in the same campaign. Millions of square miles of ocean must be patrolled and guarded as closely as a front-line post. Patrols undertaken from a distant land-base are wasteful of manpower, time and fuel. Water bases exist in infinite number and can be re-located and established elsewhere with maximum mobility. A watchful defence must have its eyes everywhere. The flying boat is the answer!

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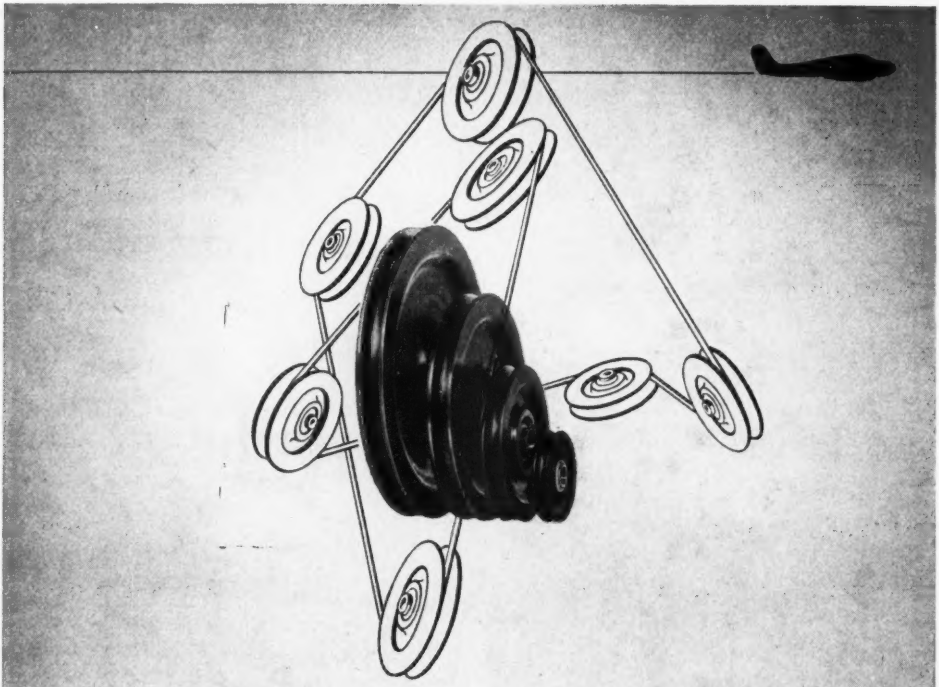

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CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

German Aviation Redivivus?

YOUR piece on German aviation (page 448, issue of April 20th) was more than interesting to me. Your point that, if permission is given to Germany to return to the field of international air traffic, we may see a revival of the Lufthansa, needs adding to, in my view. The creation of Lufthansa in the early nineteen twenties was in fact the re-creation of the Luftwaffe after the Versailles Treaty. The Focke-Wulf 200, the Heinkel 111, the Junkers 52, etc., were all military bombers first operated by Lufthansa. Since the beginning of 1950 we have learned at first hand that the Germans in the Soviet Zone have a civil aviation agreement with the Russians, that Messerschmitt has production facilities in Pakistan and is about to acquire them in South Africa (where Henschel has had a factory for about a year now) and that Kurt Tank, the Focke-Wulf designer, is making aircraft for Perón at Cordoba in the Argentine.

My point is that your German aviation item is part of a bigger picture of the revival of the Luftwaffe which is not without interest to those of us who recall the way Germany evaded the restrictions of the Treaty of Versailles, *inter alia*, by making civil aircraft in Sweden, Turkey and Russia and by using Lufthansa with consummate skill to lay the foundations of Goering's Air Force.

London, W.9. ASHER LEE.

From a German Reader

I AM German, and derive great inspiration from *Flight*. As a glider pilot, I am very interested in reading the column "Club and Gliding News."

It is very hard for us to realize that gliding enthusiasts in other countries are enjoying themselves flying while we are still standing in the background. We have not forgotten that we have lost a terrible war, but for that reason specially we should, I think, try to make connections for friendship with the other peace-loving countries. Other kinds of sports have already been carried out internationally, so why don't we get permission to start building aircraft for gliding and soaring again?

A gliding and soaring association, the German Aero Club, was formed here in 1950, but all we do at present is to build models.

I am employed as interpreter-clerk with a British unit, and would like to hear what your readers think about the future of German gliding and soaring.

Krefeld, Germany. SIEGFRIED KERSTEN.

The Corporations and Charter Work

From Sir Archibald P. Hope, Bt., O.B.E., D.F.C., B.A., A.C.A.

ON April 20th you published a letter from Mr. Stuart-Shaw which examines the vexed question of the Corporations' non-scheduled activities. Whilst this letter sets out one side of the question clearly, it ignores the other side completely.

The case presented by the non-scheduled operators is based on the claim that the Corporations are using their subsidy, paid with taxpayers' money, to assist their quotations for non-scheduled services. It has been argued by the protagonists of nationalization that, because the Corporations' non-scheduled activities reduce the subsidy, the subsidy is not being used. This, of course, is illogical nonsense.

If this argument is carried to its ultimate conclusion, it would mean that the Corporations could undertake non-scheduled or charter work at prices which covered their basic operating costs (as suggested by Mr. Stuart-Shaw), plus one penny contribution to their overheads, thus reducing their subsidy by that amount. The private enterprise operators, however efficient they may be, obviously cannot reduce their overheads beyond the true amount, and it follows inevitably that, if the Corporations are allowed to persist in their present policy, the non-scheduled operators must be forced out of business.

The non-scheduled operators, therefore, contend that the Corporations' present policy is contrary to public policy for at least three reasons. First, the non-scheduled operators acquired their aircraft and built up their business on the strength of numerous Ministerial pronouncements, both inside and outside Parliament, that the Corporations would not be allowed to use public money to compete against them. These protestations are now lightly thrust aside, on the grounds that it is necessary to protect the taxpayer's pocket. This argument was just as valid when the promises were made, and surely the non-scheduled operators are entitled to point out the breach of good faith by a Government whose promises encouraged them to invest large sums of money. Secondly, if the Corporations persist in their present policy, for the reasons outlined above, the non-scheduled operators must be forced out of business. From the point of view of national defence, it is at least also arguable that this would be unfortunate. Thirdly, a better way to reduce the taxpayers' loss—and no one denies the desirability of doing so—would be for the Corporations to get rid of their surplus aircraft and surplus staff, rather than operate non-scheduled services with them at prices which are economically indefensible. The Corporations will doubtless deny that they have surplus aircraft, but examination of their published figures for the past five years shows that their utilization is far below that of many other international operators, and even of some British non-scheduled operators. Only when they actually achieve really high utilization can they justifiably claim that they have no surplus aircraft and are merely using spare capacity for non-scheduled services.

London, W.1. A. P. HOPE,
Manager, Commercial Dept., Airwork, Ltd.

Board of Old Warriors

THE writer of your report of the R.F.C.-R.N.A.S. reunion wonders whether, had Maurice Wright been able to attend the recent R.F.C.-R.N.A.S. reunion, Fairey's would not have had "a First World War Service trio which, perhaps, no other aircraft firm could equal."

Well, four of the five executives named on our letter heading were all in the R.F.C. Moreover, George Cornwall, chief designer, was an observation-balloon officer in the R.F.C.; so five of our top executives were entitled to attend this reunion, a fact of which we are extremely proud.

Hounslow, Middx. G. A. LINGHAM,
Heston Aircraft Co., Ltd.

[The four are Sir Norman J. Watson (chairman), B. R. S. Jones and G. A. Lingham, D.F.C. (joint managing directors), and G/C. G. H. Bowman, D.S.O., M.C., D.F.C.—Ed.]

The Olympia Sailplane

WITH reference to the statement reproduced in your issue of April 6th, "A Sailplane's Nationality," we feel that for accuracy's sake and in fairness to my late partner, the Hon. Andrew Dalrymple, and members of our staff, it should be mentioned that most of the modifications referred to were originally carried out by us.

We obtained a set of German drawings in 1944 and spent a great deal of time and trouble (and, I regret to say, money) in translating these into English materials and dimensions.

We supplied the prototype machine to Mr. Dudley Hiscox, but when it became apparent that we were not in a position to fulfil all the orders received in a reasonable space of time, we disposed of the project to the present makers, to whom the wings had been originally sub-contracted.

As a matter of interest, Mr. Hardinge of Australia constructed his *Yellow Witch* from a set of our drawings, assisted by some fittings and a certain amount of correspondence.

Hungerford, Berks. CHILTON AIRCRAFT CO., LTD.
A. R. Ward, Managing Director.

Facing the Tail

YOU commendably deal editorially with the thorny question of backward-facing seats in your April 27th issue. May I contribute a passenger's viewpoint on some of the points you raise?

Firstly, as a passenger, I am surprised that I.A.T.A. believes it possible to take an abstract viewpoint of air safety—you report them as acknowledging the merit of backward-facing seats in this respect, but not favouring any immediate move towards standardization. (I personally would feel most insecure in an aircraft if I thought that either designers or operators approached the general problem of air safety as indifferently as they appear to regard this particular one.)

It seems to me that a considerable number of red herrings are drawn across the trail when arguments are advanced against the adoption of backward-facing seats. The cardinal point that if even the *existing* types of seats were merely turned round to face the other way, air safety would be greatly improved (by giving passengers a much greater chance of survival and escape from injury in a crash), is side-tracked by critics stressing instead the

CORRESPONDENCE . . .

additional cost of giving extra protection to withstand g loads which are not a requirement at present.

Similarly, as you point out, the reclining-back or sleeperette type of seat is fitted in some aircraft (though need I add only a relatively few?); but even if there is little advantage in reversing the direction in which such seats face (which would be hard to prove), this surely is no argument against doing so in the case of the far more common ordinary type of passenger seats provided.

Again, what does it matter what upper limit of acceleration (or, rather, deceleration) passengers can withstand, save from the point of view of possible additional strengthening of seats, when it is known that survival-rate at any degree of deceleration is superior in the backward-facing seat?

Payload, similarly, is in no way affected, unless operators, in their mercy, are prepared to sacrifice profits still further to increase the additional protection inherent in merely turning seats round the other way.

As for evidence of passengers' views in general, I would refer you to a 1947 report, by W/C. Dudgeon, which showed that 80 per cent of passengers on scheduled services questioned in 1946 by Transport Command preferred facing backward, 99 per cent thought the view better, and all found bumps and noise less noticeable and either felt no more prone or even less prone to airsickness. Similar figures were obtained in a U.S.A.F. survey, also made in 1947, when 94 per cent of passengers favoured backward-facing seatings and 88 per cent wanted *all* seats reversed. The latter report, incidentally, concluded that the human body can withstand 20g transversely for brief intervals and that crushing injuries are 40 times more numerous than fire as the primary cause of death in aircraft crashes.

East Twickenham, Middx. VIGILANT.

Infallible Glider

I READ with great interest, in your issue of March 9th, the note on the performance of the *Macrozanonia Macrocarpa* seed as an inherently stable glider.

The principle was tried as long ago as 1903 by Etrich and Wells in Austria, with more or less success. They built a man-carrying glider, into which they put an Antoinette engine. It would not take off, so they built another, the Taube (pigeon), which had a tail and flew fairly well. I built the propeller for the first hop.

Then they sold the patent rights to Rumpler in Germany. The patents, however, were voided, because one German professor, writing in a magazine, mentioned the use of the principle previous to the building of the Taube.

The advanced aeronautical knowledge now available suggests that a better design, on this principle, could now be achieved.

Chicago, U.S.A. RAOUL J. HOFFMAN.

A COMPACT AUTOMATIC OBSERVER

IN the flight-testing of aircraft it is usually essential to provide an automatic observer to record transient conditions and to provide photographic or similar records that may be analysed after flight. In design, these observers tend to become bulky and heavy and at times extremely complex. In the larger aircraft, with commodious cabin or bomb-bay space, physical dimensions and weight are comparatively unimportant and the instrument engineer can really spread himself. In the smaller aircraft, the disposition of the equipment, while still leaving room for the crew and also keeping the weights and the "c.g. king" happy, can provide a real problem.

With this in mind, a small automatic observer has been developed by the instrumentation department of Percival Aircraft, Ltd., for installation in trainer and similar types. With a particular aircraft in mind, it was intended that this unit should be complementary to a human observer: it was not intended to be a fully comprehensive auto observer. It is, however, capable of a far greater range than were the observers previously in use. It was further designed for mounting in a small space that was available in the tail of the aircraft, and had to be fitted and removed through a small inspection door. The basic dimensions of the unit are 10in high, 10in wide and 15in long. This last dimension can, if necessary, be reduced to 12in by fitting a prismatic attachment on the camera lens and turning the camera through 90 deg. The unit, complete with mounting tray, weighs 14 lb.

Provision was made for up to 12 Dessyn repeaters (the number depending on the dial size), an altimeter, an air-speed indicator, a clock, and message registers for recording fuel consumption and for numbering the shots.

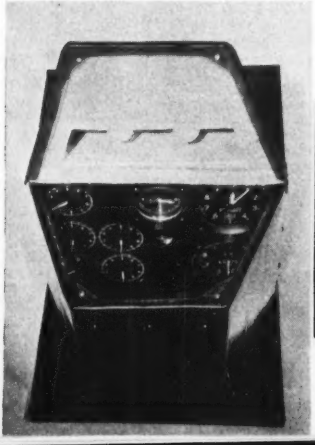
The Dessyn units are direct mounted on to a small sub-panel. The 11in diameter Dessyn units are mounted on the back of this panel and the 100-scale division dials are reproduced photographically on the front. This sub-panel is set back from the main panel to bring the plane of the Dessyn dials parallel with the dials of the normal cased instruments and is made quickly detachable so that changing the instruments presents no difficulties. All the Dessyn connections are taken into one Breeze plug and all electrical connections to the observer are made through another.

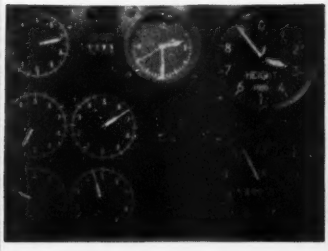
The camera is a Fairchild gun-sight aiming-point camera, fitted with a ½in reversed telephoto lens in a screw mount. The camera is mounted on an easily removable bracket behind the panel, and photographs through a mirror mounted opposite the instruments. The camera loads with 50-ft magazines of 16-mm ciné film, which give two minutes' continuous running at the lowest shutter speed of 16 frames per second. This would give too many frames and insufficient duration for normal work but, by using a simple mechanical time-switch in the control line, it is possible to operate at the equivalent of one frame per second or upwards. Speeds of 48 or 64 frames per second are also available if desired.

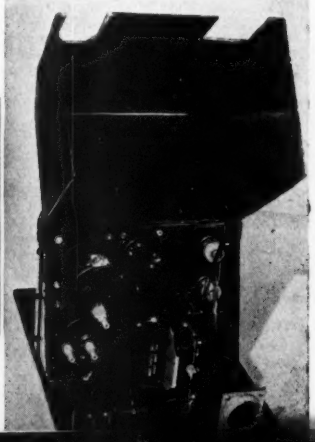
Illumination is by means of two 30-watt lamps mounted behind a diffuser in a ventilated lamp-house on the hinged lid covering the dial side of the panel. A reflector is mounted in the bottom of the unit to look after the lower half of the panel. Using Ilford HP3 negative film, this lighting is adequate even on aircraft battery voltage. By careful positioning of the lamps, flare and shadow have been avoided.

Test switches are provided, and the complete unit is mounted on a radio tray. It can be removed from the aircraft for servicing or calibration by withdrawing two pins, and the complete removal and disconnection from the aircraft can be effected in two minutes. A small double mirror fitting obviates parallax errors during calibrations. Access to each side of the panel is by hinged covers.

Variations of the basic unit have been built for various purposes but the basic design is capable of providing up to 20 separate indications in a unit of small size, if the existing large S.A.E. case instruments are replaced by Dessyns or miniature instruments.







(Left) The automatic observer, with lid raised to show dials. (Centre) Reproduction from film record of readings. (Right) Rear of the panel, showing the method of camera mounting.

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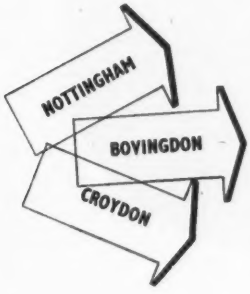

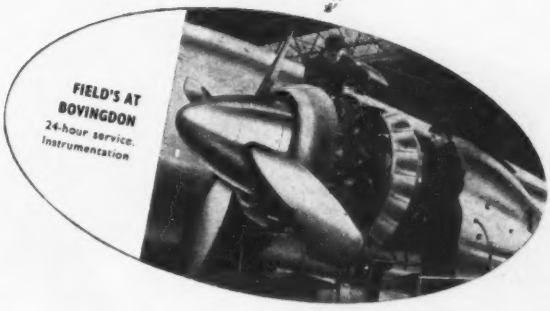

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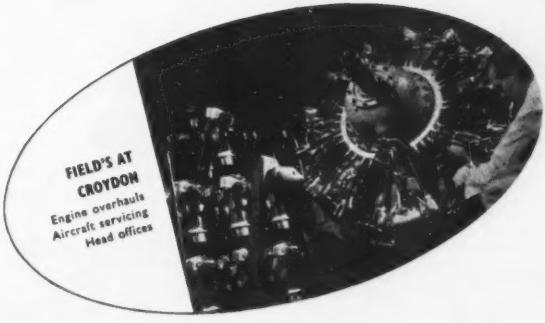

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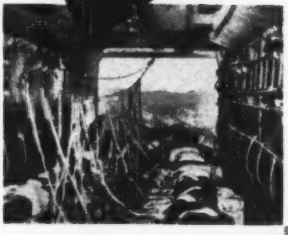
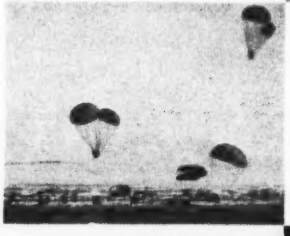


1 ready to go

2 the shove-off



3 safe landing

U. S. Air Force Photos

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SERVICE AVIATION

Royal Air Force and Naval Aviation News

FIGHTER BOMBER: Two 1,000 lb bombs comprise the external armament load of this de Havilland Venom F.B.1, as now in quantity production for the R.A.F. The Venom has a marked superiority in performance over the Vampire and its longer endurance will be especially valuable in army-support operations.

THE PLYMOUTH DISPLAY

ORGANIZED by an inter-Services and civilian committee, the air display held at Roborough, Plymouth, last Saturday attracted a crowd variously estimated at between 10,000 and 20,000, so Service charities and a local nursing fund should benefit accordingly.

Arriving from London in an Anson, the Under-Secretary of State for Air, Mr. Aidan Crawley, M.B.E., M.P., opened the proceedings in weather which, while slowly improving, was still thick enough to compel a complete programme-reorganization in view of the probability that high-speed aircraft would be unable to appear. That the changed order was ultimately run through without a single hiatus is greatly to the credit of 19 Group, Coastal Command, who were mainly responsible for the flying side of the organization.

Among the senior R.A.F. officers present were the S.A.S.O. of the Command, A.V-M. A. C. Stevens, C.B. (who is acting A.O.C.-in-C. in the absence of Air Marshal Sir John Steele, C.B., D.F.C., on sick-leave) and the A.O.C. 19 Group, A.V-M. G. R. C. Spencer, C.B.E.

The task of Flying Control was made the more difficult by the fact that most of the participating aircraft arrived over the scene direct from distant airfields, Roborough's grass field being too small for anything large or fast.

F/L. Lee, an instructor from No. 10 Reserve School, Exeter, led off with some crazy flying reminiscent of those classic efforts at Hendon Displays in days of yore; once or twice he literally stroked the grass with his Tiger Moth's wing-tips. Three Sunderlands from Pembroke Dock flew over at impressively low altitude, followed by a Sea Otter from the same station. Then it was the Army's turn, Capt. T. E. Forrow, in an A.O.P. Auster from 657 Sqn, Middle Wallop, demonstrating in conjunction with an R.A. battery; at times the little aircraft was floating along on its flaps at less than 30 kt.

Next came ten minutes of brilliant close-formation work by three instructors from C.F.S., Little Rissington, during much of which their Tigers were at less than tree-top height and being pretty severely bumped by deflected breezes. The low ceiling now began to lift, and a pilot from the Central Gunnery School, Leconfield, was able to keep his Spitfire 16 within sight of the ground during the major part of a clean-cut, nicely lined-up display of solo aerobatics. Five more "heavies" now flew over (Lancasters from St. Eval), then it was the Navy's turn, a Dragonfly helicopter from Gosport (Lt. Farquharson) effectively rescuing the occupant of a dinghy from the storm-tossed grass—and, incidentally, causing joy by removing a few dozen spectatorial hats with its rotor down-wash. There followed a loud and spectacular beat-up by a formation of Sea Furies from No. 802 Squadron, four of which afterwards peeled off for some very polished formation aerobatics.

Next was a ceremonial item—the Under-Secretary's presentation of Colours to the local (No. 1518) squadron of the Women's Junior Air Corps. Mr. Crawley was accompanied at the saluting base by Mrs. Spink, W.J.A.C. National Director, Mrs. Collins, the squadron's C.O., and A.V-M. Spencer.

A close-quarters demonstration of parachute jumping from a baloon obviously delighted the crowd. R.A.F. instructors made the first descents, and were followed by men of the 16th Airborne Brigade and Royal Marine Commandos. The final jump, in which the parachutist "spilled" his canopy all the way down, caused some very audible gasps.

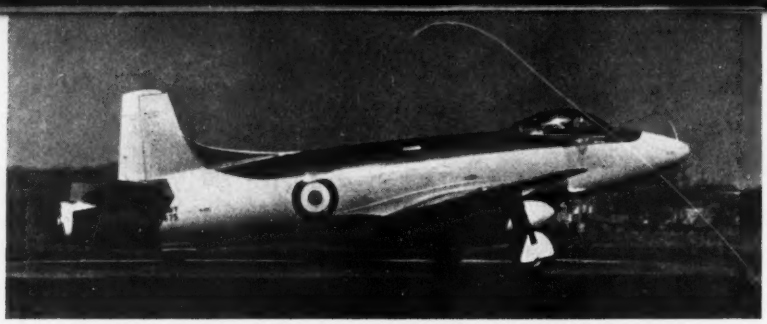
Another ground item—P.T. by R.A.F. personnel from Collaton Cross—took place, and then four very assorted heavy aircraft flew over; a Shackleton from Kinloss, a Hastings Met I and a Halifax from Aldergrove, and a Washington from Coningsby. Their long journeys were made as training flights for the crews, the object—being a spot-on arrival.

The weather had by now relented sufficiently for the jets to perform—ordinarily they would have appeared earlier in the programme—and their contribution made a spectacular *finale* to the flying programme. It was difficult to say which was the finer performance: the formation aerobatics by three Sea Vampires from Culdrose (Lts. Clarke, Rawbone and Black) or the individual contribution by S/L. N. Clayton in a Meteor 8 from Tangmere. The Meteor's wig-tips trailed pennons of vapour on every turn, and when Clayton did a vertical climbing roll to 5,000 ft he left a visible corkscrew in his wake.

During the afternoon the W.R.A.F.

"Flight" photograph

DOWN IN DEVON: Mr. Aidan Crawley, Under-Secretary of State for Air, takes the salute from the Women's Junior Air Corps contingent at the Plymouth Display described in this page. On the left is A.V-M. Spencer, A.O.C. 19 Group, and just behind Mr. Crawley are Mrs. Spink, W.J.A.C. National Director, and Mrs. Collins, C.O. of the Plymouth squadron.



ATTACKER INNOVATION: The production version of the Vickers-Supermarine Attacker carrier-borne fighter (Rolls-Royce Nene) now has a dorsal fin, as here seen. It will be noted that the sea camouflage has been so applied that the new fin is not instantly apparent.

SERVICE AVIATION...

Central Band had played, and the Band of the Plymouth Group, Royal Marines, ended the day by beating Retreat, during which the C.-in-C. Plymouth, Admiral Sir Rhoderick McGrigor, G.C.B., D.S.O., took the salute.

A word must be added about the excellent static show, to which all three Services contributed. Its highspot, undoubtedly, was a Derwent I instructional rig from the R.N. Engineering College, which was run under power—mercifully after the Display was over, otherwise the commentary (on which F/L. R. O. Blackall of 19 Group H.Q. deserves felicitations) would have been effectively drowned.

Defence of Great Britain

THE Government announced last week that, in the event of war, responsibility for the defence of the United Kingdom would be held by three commanders-in-chief responsible to the Chiefs of Staff. Chairman of the trio would be the C.-in-C., U.K. Land Forces, and he would work with the C.-in-C., Home Station, and the A.O.C.-in-C., Fighter Command. The officers holding these posts at present are, respectively, General Sir Miles Dempsey, Admiral Sir Arthur Power and Air Marshal Sir Basil Embry.

Manchester Vampires

USING information supplied by the Air Ministry, we stated in a recent article (*Auxiliaries Called-up*) that No. 613 (City of Manchester) Squadron had not yet been re-equipped with jet aircraft. In actual fact, the Squadron changed Spitfire 22s for Vampire 5s some two months ago. Two Meteor 7s have also been allocated for training. The initial conversion was carried out at Woodford, but "613's" Vampires are now operating from the normal Squadron base at Ringway.

Air O.P. Gathering

THE Army and R.A.F. were strongly represented in the Officers' Mess of the Inns of Court Regiment, located in the tranquil precincts of Lincoln's Inn, when No. 661 Auxiliary Air Observation Post Squadron entertained their friends on the evening of May 1st. The C.O. of the Squadron is Maj. R. J. Hutt, Royal Artillery.

Lt.-Gen. Sir Otto Lund, K.C.B., D.S.O., Representative Colonel Commandant of the Royal Artillery for 1951, thanked the squadron on behalf of the guests, and referred to the short but distinguished history of the unit. It was formed at Old Sarum in August, 1943, and trained with the 1st Canadian Army. On June 21st, 1944, "C" Flight landed in Normandy and was engaging German tanks on July 26th. The remainder of the squadron crossed to Normandy on July 31st, 1944, and advanced into Germany. It was in action at the Falaise Gap, Boulogne, Calais, Dunkirk, Walcheren, in the Scheldt Pocket, at Arnhem, Nijmegen, and the Rhine crossing. "C" Flight was the first Air O.P. unit in Holland and Germany. After the surrender of Germany the squadron was engaged on communication flying and was disbanded on October 31st, 1945.

On May 1st, 1949, the squadron was re-formed as an Auxiliary unit to support the Royal Artillery Field and Medium Regiments of Eastern Command. It now has five flights and a mobile servicing section, located as follows: H.Q. 661 Squadron, 3661 Mobile Servicing Section, 1957 Flight and 1960 Flight at Kenley; 1958 Aux. Air O.P. Flight at Hendon; 1959 and 1961 Aux. Air O.P. Flights at Henlow. The squadron is well staffed with Territorial Army pilots, but volunteers are urgently required to fill vacancies in the ground staff

Badge for U.L.A.S.

AT a short ceremony held at Booker airfield on Saturday last, the University of London Air Squadron was presented with its approved badge by A.V-M. F. H. M. Maynard, C.B., A.F.C., R.A.F. (Retd.), who had flown up from Devon, where he is now living. A.V-M. Maynard was the squadron's first commanding officer, in 1935. In a brief speech before the presentation he gave a condensed history of the U.L.A.S., mentioning in passing that one in six of the pre-war members received awards and honours which included four D.S.O.s, 18 D.F.C.s and two M.B.E.s

W/C. A. V. Rogers, A.F.C., the present commanding officer, accepted the badge on behalf of the unit. A.V-M. W. J. Seward, C.B.E., A.O.C. No 61 Group, Home Command, attended the ceremony.

National Servicemen for Canada

THE third party of National Service aircrew—31 pilots and 23 navigators—to be posted to Canada for flying training left recently by air for Montreal. Since the scheme for training R.A.F. pilots and navigators in Canada was inaugurated in January last, 89 pilots and 48 navigators—all National Servicemen—left England to receive training at R.C.A.F. schools. Pilots are trained at Gimli, near Winnipeg, and navigators at Summerside, Prince Edward Island.

All R.A.F. pilots and navigators are now commissioned after successfully completing initial training and the party leaving this week rank as acting pilot officers, having gone through initial training school.

R.N.V.R. Summer Training

SUMMER training—ashore and afloat—is now being organized for the five air squadrons of the R.N.V.R. The only Scots unit—No. 1830 Squadron, equipped with Fireflies for anti-submarine work, and based at Donibristle—will sail from the Clyde for a fortnight in the light fleet carrier *Vengeance*. During its training afloat, 1830 Squadron will operate in the Irish Sea and Channel, visiting the Scilly Isles.

The three Seafire squadrons will visit St. Merryn during June and July to cooperate in tactical exercises with R.N. carrier air groups. These units are Nos. 1831, 1832 and 1833 Squadrons, based, respectively, at Stretton, Culham and Bramcote. Last year they carried out their annual training at sea.

No. 1840, the new Firefly A.S. squadron formed at Culham, will move to its permanent base at Ford and begin continuous training after a short "working-up" period.

"Flight" photograph

PRESENTATION: W/C. Rogers receiving the new U.L.A.S. badge from A.V-M Maynard, as recounted in the paragraph above. In the centre is A.V-M. Seward, A.O.C. No. 61 Group.

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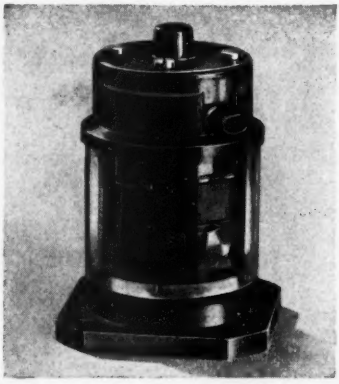

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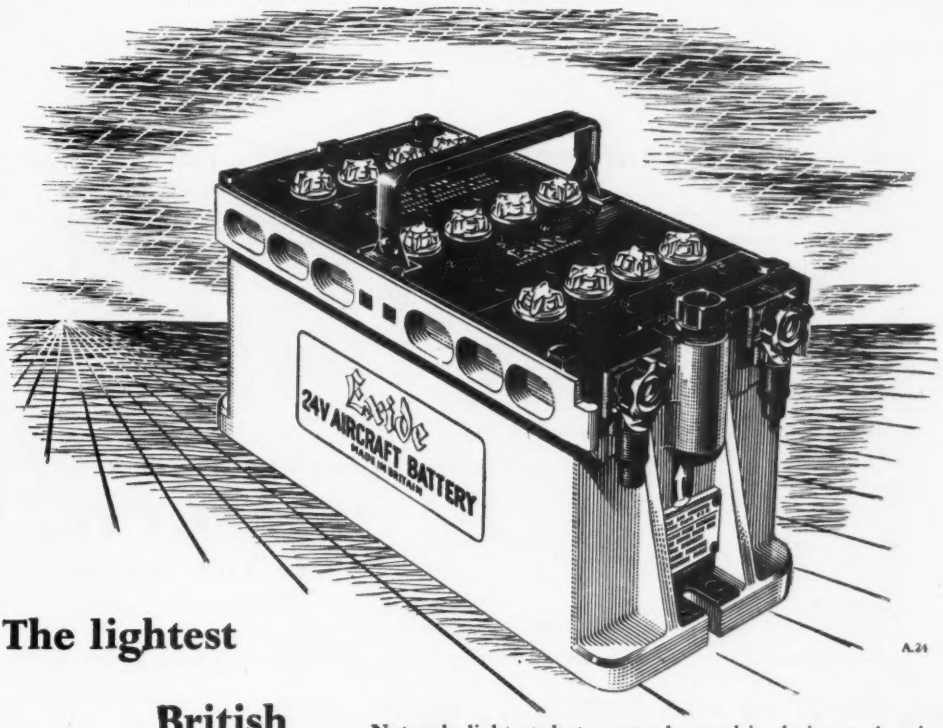

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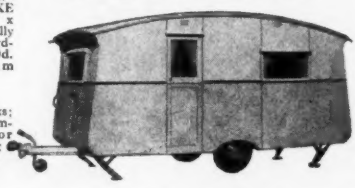

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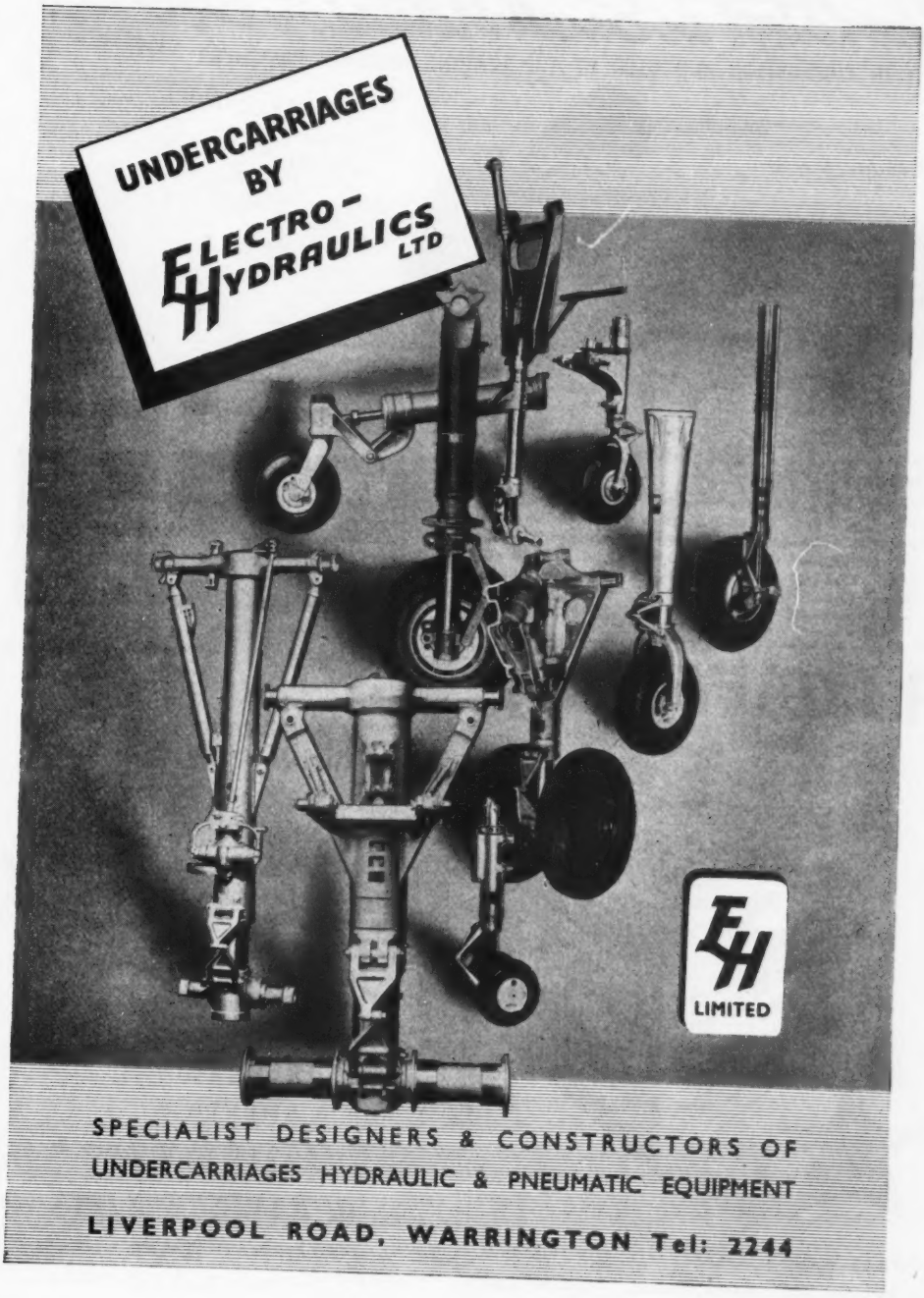
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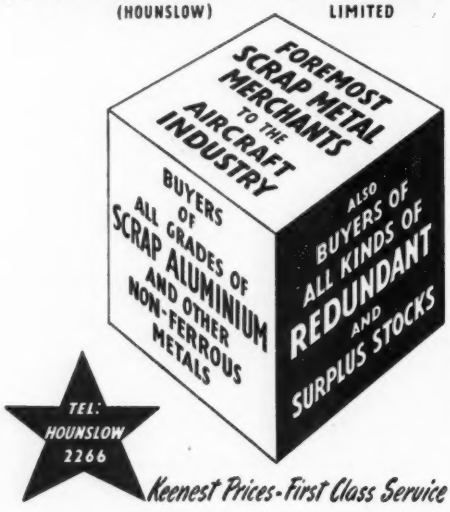
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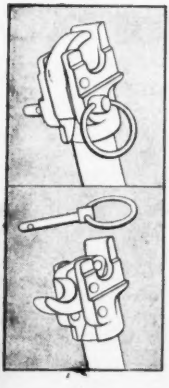

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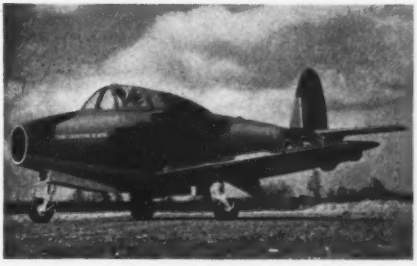

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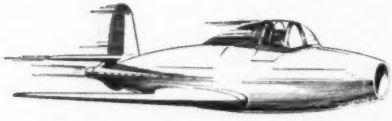

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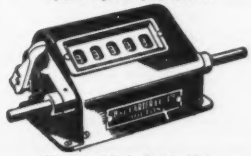

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